WCC REFERENCE ROOM
Vancouver Assembly
No. 12

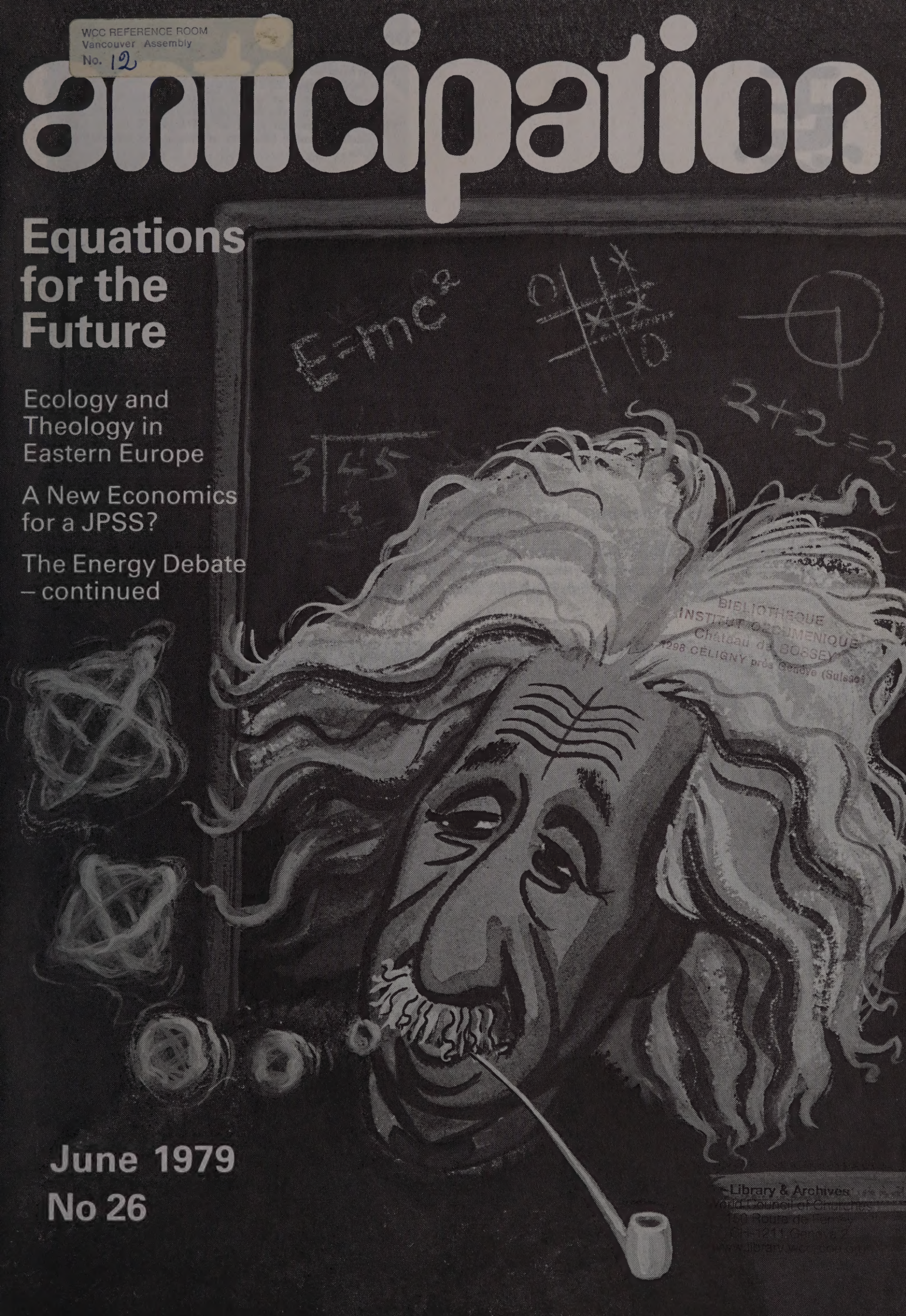
anticipation

Equations for the Future

Ecology and Theology in Eastern Europe

A New Economics for a JPSS?

The Energy Debate – continued



BIBLIOTHEQUE
INSTITUT OECUMENIQUE
Château de BOSSEY
1298 CELIGNY près Genève (Suisse)

June 1979
No 26

Library & Archives
World Council of Churches
150 Route de Ferney
P.O. Box 2100
1211 Geneva 2
www.library.wcc-coe.org

anticipation

No. 26 **June 1979**

CHRISTIAN SOCIAL THOUGHT IN A FUTURE PERSPECTIVE

Church & Society, World Council of Churches
150, route de Ferney 1211 Geneva 20

Cover: *1979 marks the 100th anniversary of the birth of Albert Einstein. The caricature is taken from a colour original by John P. Taylor, who is in charge of Film and the Arts for the WCC. Einstein was not only a great scientist but a remarkable human being who exemplified the concern for a responsible science.*

CONTENTS

page

I. Science, Ecology and Theology in East European Perspective
Report from the Consultation in Erfurt, German Democratic Republic, August 25-28, 1978 5
Christians in a Socialist Society – Their Responsibility for the Environment and the Future of Humanity 8
Faith and Science in Light of the Social-Religious and Cultural-Scientific Situation in Poland, *by Msgr. Jozef Majka* 20

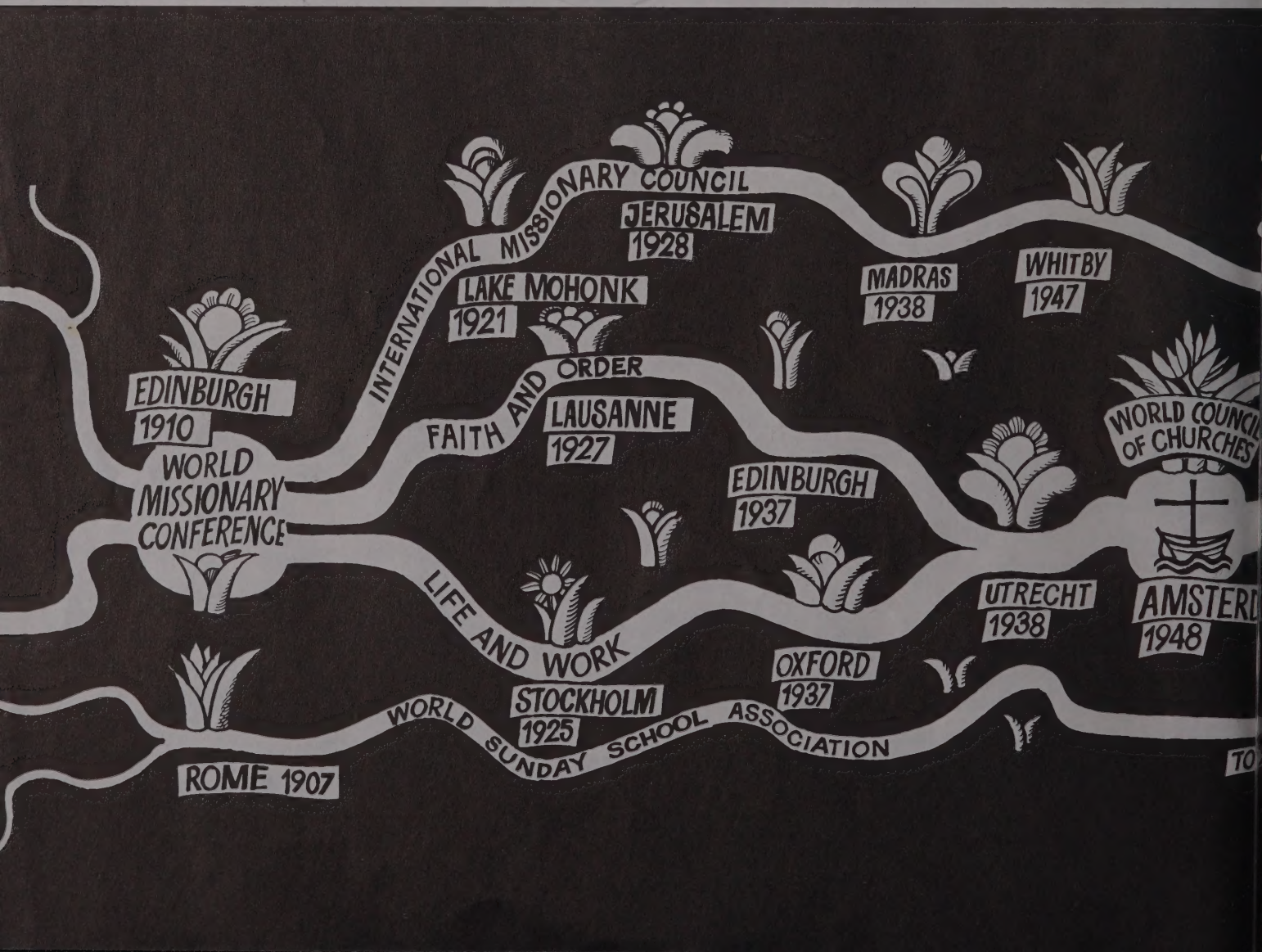
II. Media for the Meeting 24

III. A New Economics for the JPSS? *(Report of a Consultation on Political Economy, Ethics and Theology* 25

IV. The Energy Debate – Continued. *(Report from the WCC Consultation on "Ecumenical Concerns in Relation to Nuclear Energy")*
The Report of the Consultation 32
Statements and Reactions by some Members of the Consultation 49
A Statement by the Working Committee of Church and Society 51
Faith, Science, Ideology and the Nuclear Decision, *Roger Shinn* 53
Nuclear Fission – A Peril and a Hope, *Victor Weisskopf* 57
Should Radiation Exposure from the Operation of Nuclear Power Plants be Reduced?, *Karl Z. Morgan* 60
Radioactive Waste Management, *P.J. Dyne* 66
Do we need Nuclear Energy at all?, *Gerald Leach* 68
International Development and Control of Nuclear Technology, *Sigvard Eklund* 71
Two Statements from Churches on the Nuclear Energy from France and Italy 74
Two Comments on the Harrisburg Reactor Accident from Church groups:
– A Statement on the Three Mile Island Nuclear Accident, *from Lancaster Theological Seminary* 77
– Facing Nuclear Terror in Harrisburg, *William C. Mielke* 79

V. Conference of Science Students 81

VI. A Tribute to Margaret Mead 83



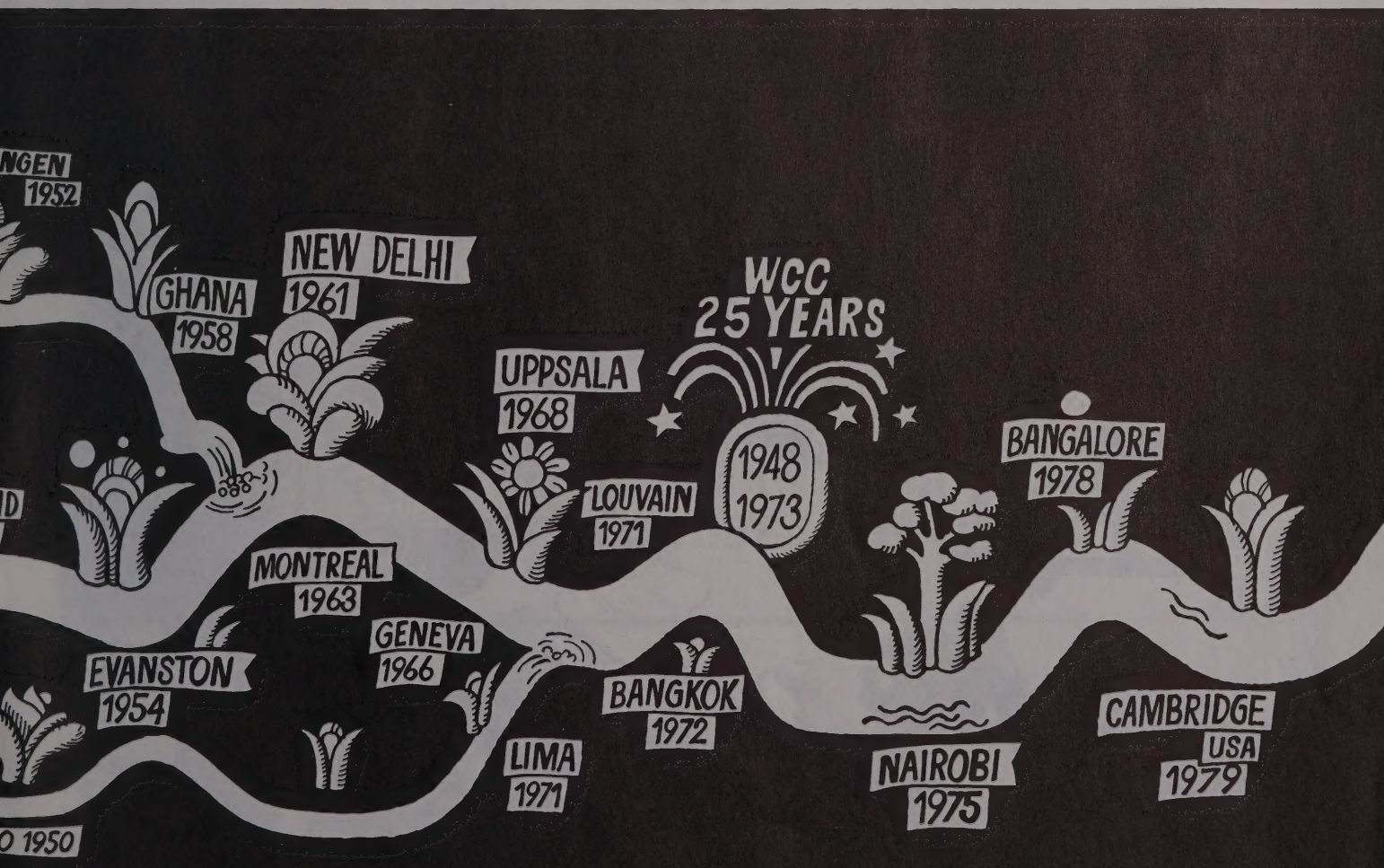
AT WCC MIT

As we go to press there are 47 days to zero!

Note to our Readers:

This issue presents largely papers and reports from three ecumenical consultations on controversial themes, held in 1978 in preparation for the Conference on Faith, Science and the Future, at the Massachusetts Institute of Technology, Cambridge, Mass, U.S.A., July 12-24, 1979.

I. Science, Ecology and Theology in East European Perspective. The Contribution of Churches in the Socialist Countries of Eastern Europe to the WCC Programme on Faith, Science and the Future. The consultation on this theme met in the historic town of Erfurt in the German Democractic Republic, August 1978. In addition to a report on the Conference we include two of the papers presented, one from the churches in East Germany, and the other an address by a Polish Roman Catholic churchman and scholar.



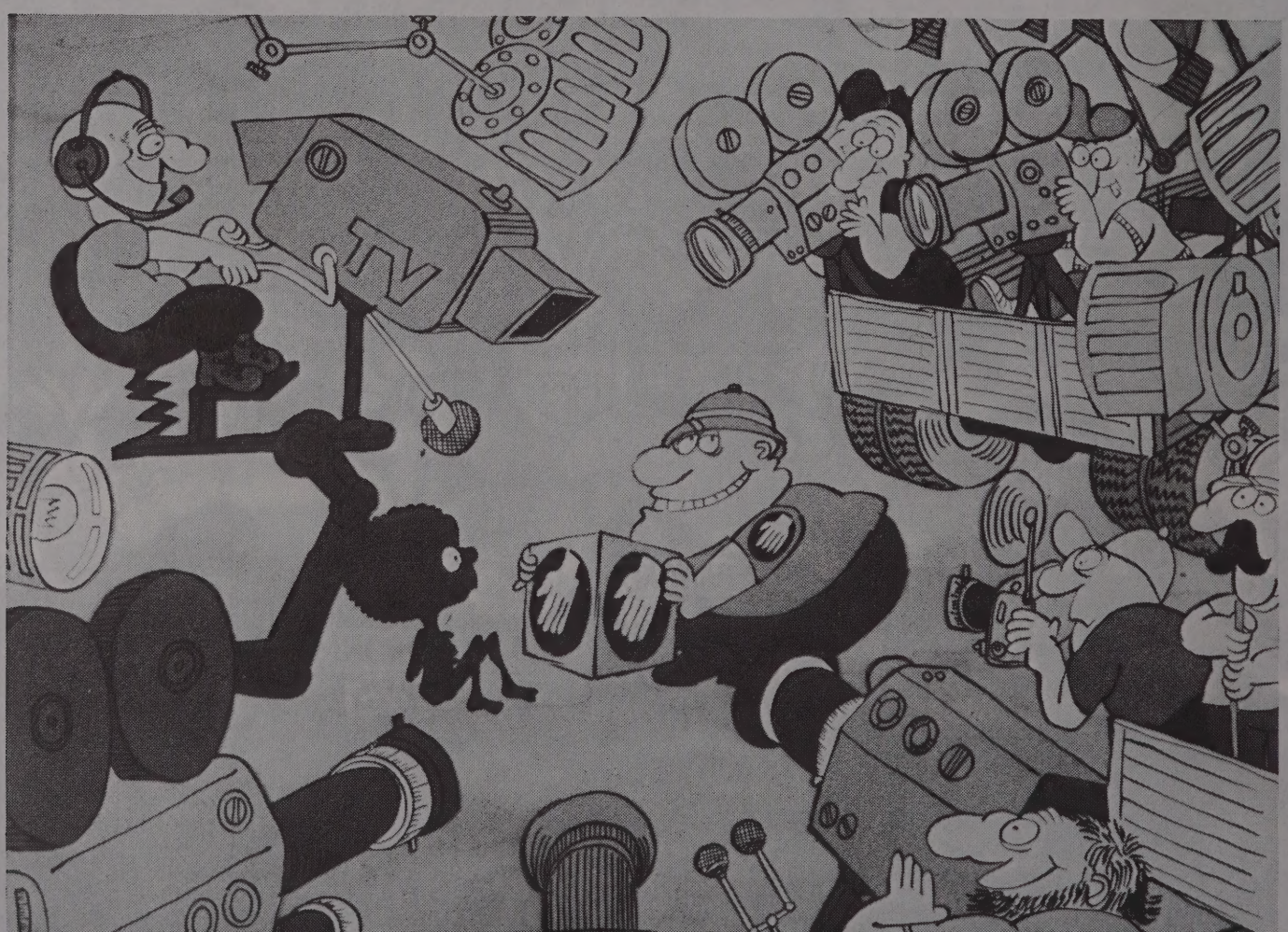
II. A New Economics for the JPSS? – Report of a Consultation on Political Economy, Ethics and Theology. Church and Society collaborated with the WCC Commission for the Churches Participation in Development (CCPD) to organize this consultation (Zürich, June, 1978) on the implications for Christian social ethics of new developments in economic thought. The consultation brought together 25 economists from all parts of the world, and the report of their meeting, published here, opens a new chapter in the long ecumenical discussion of Christianity and economic problems. JPSS stands for the Just, Participatory and Sustainable Society – a new ecumenical vision.

III. The Energy Debate – Continued: Ecumenical Concerns in Relation to Nuclear Energy. The provision of energy, taken for granted for so long, has emerged as one of the central economic and technological – and ecumenical – issues of our time. What appear to be independent developments (whether in the Persian Gulf or in Harrisburg, Pennsylvania) contribute to a new dimension of to human anxiety, and to the ever widening debate about nuclear energy as a replacement for the traditional fossil fuels on which industrialized societies had come to depend. The Consultation held in Geneva, May, 1978 added to our ecumenical understanding – and to our awareness of the growing concern and division within the churches on this critical issue. The Working Committee on Church and Society at its meeting in September 1978 reviewed the report from the May Consultation and formulated its own statement on the subject. Both of these documents are included here, along with papers submitted to the Consultation or arising from the continuing nuclear debate in other circles. The World Council of Churches' Central Committee, meeting in Jamaica in January 1979 received the report of the Consultation and the statement by the Working Committee and commended them to the member churches for their study and response. These papers will be submitted to Section VI on *Energy for the Future,* at the World Conference in July.

The latest development, the accident to the nuclear reactor at Three Mile Island, in March 1979, has added fuel to the debate about the risks of nuclear power technology. Two recent documents from the U.S.A. are added here to show how the churches have been involved in that discussion. We are grateful to *The Christian Century* and to Pastor William Mielke of the Olivet Presbyterian Church of Harrisburg for permission to reproduce the report by Rev. Mielke on "Facing Nuclear Terror in Harrisburg".

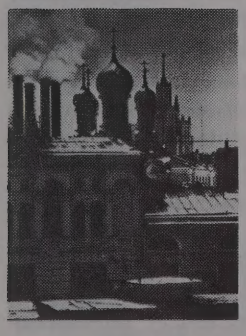
* * * *

"Helping Hand" is one of many short films that will be a part of the Conference in Cambridge. This production deals with the paternalism that still marks relations between the rich and poor and the role of the media largely controlled by the rich countries. As this copy of Anticipation goes to press this WCC film production is being shown in the official programme at the Cannes Film Festival.



I

Science, Ecology and Theology in East European Perspective



REPORT FROM THE CONSULTATION IN ERFURT, GERMAN DEMOCRATIC REPUBLIC, AUGUST 25-28, 1978

At an early stage in the World Council of Churches' study and action programme on Faith, Science and the Future it was agreed that this work would not be complete without a substantial contribution from the Churches in the socialist countries. While these Churches participated in the WCC Conference on Science and Technology for Human Development, in Bucharest, Romania, July 1974, their input then was mainly of a theological nature. Moreover the issue of the "Sustainable Society" which emerged as a theme for ecumenical study at the Bucharest Conference posed a challenge to Christian social thinking in industrialized countries of all types.

An invitation from the Federation of Evangelical Churches in the German Democratic Republic to hold the 1978 meeting of the WCC Working Committee on Church and Society in their country opened up the possibility for a consultation with the Churches in the socialist countries of Europe on these issues. This Consultation, and the meeting

of the Working Committee were both held in the historic Augustinerkloster of Erfurt in the GDR, where Martin Luther began his monastic life.

1. Nature of the Erfurt Consultation

The Consultation was attended by 20 theologians and scientists representing Churches in the USSR, Poland, Czechoslovakia, Hungary, Romania and the GDR. In addition there were six members of the Working Committee on Church and Society from Churches in Australia, France, India, the USA and the Netherlands. The Consultation was chaired by Bishop Paulos Gregorios, Metropolitan of New Delhi. In two brief opening presentations Metropolitan Gregorios and Prof. Charles Birch, the officers of the Working Committee, outlined the theological and ethical issues arising from the WCC Programme on Faith, Science and the Future, which were to be considered at the World Conference on this theme in Boston, USA, in July 1979.

The participants from the Churches in Socialist countries then expressed their concerns. Presentations were made by Archpriest Kravshenko of the USSR; Prof. K. Huszti of Hungary; Dr Heino Falcke, Propst of Erfurt; and Dr Pumr and Dr Jaro Krivohlavy of Czechoslovakia. In addition, the Roman Catholic theologian, Monsignor Jozef Majka, President of the Pontifical Faculty of Theology of Wroclaw, Poland, presented a paper on "Faith and Science in the Light of the Socio-Religious and Scientific-Cultural Situation in Poland". At another session Prof. Rubischeck, Professor of Geography and Economics at the University of Halle, spoke to the Consultation on "Aspects and Problems of the Man/Environment Relationship" from the perspective of a scientist from the GDR.

In his presentation Dr Falcke interpreted the results of a study undertaken by the Committee on Church and Society of the Federation of Evangelical Churches in the GDR on "Christians in a Socialist Society: Their Responsibility for the Environment and the Future of Humanity". This study has since been completed and it and the paper by Monsignor Majka are published in this issue of *Anticipation* as examples of the development of Protestant and Catholic thought in the Socialist countries of Eastern Europe on the issues of Faith, Science and Technology.

After these presentations and discussions in plenary the Consultation divided into two working groups to consider specific concerns and issues posed in the reports from different Churches.

The Consultation concluded with a reception given by Mr Hans Seigewasser, the State Secretary for Church Affairs in the GDR, in which the Mayor and other leaders of the Church and State in Erfurt also took part. Mr Seigewasser expressed his deep interest in the themes of the Consultation and told the group of his own personal interest in closer cooperation with Christians in the struggle for social justice and peace in the world.

2. Findings of the Two Working Groups

Group A gave its attention to the Marxist perspective in relation to fundamental problems of Science and Value, the place of human creativity as an aspect of universal creativity, the importance of the work for a sustainable society in relation to human needs, and the control and freedom of human beings in a technological society. Group B dealt with the issues of practical cooperation between Christians and Marxists in the struggle for a sustainable society.

The conclusions of the Working Groups may be summarized as follows:

Group A noted that Marxism rejects the theory of value-free science, and emphasizes the intertwining of Science and Technology in the interest of the social classes. According to this view: "The sciences are, on the one hand, integrated *theoretically* in the scientific world-view of dialectical materialism and political economy and, on the other hand, are involved *practically* in the organization and planning of the whole society for human goals." From the Christian perspective the Group addressed three questions to this view which involved Science and Technology in a total concept of values and political strategies:

- Is it not straining the methodology and theory of science to found it on a total world-view, involving a value system and the question of the meaning of human life?
- Can this world-view, regarded scientifically, be more than a hypothesis that has to be proved in the work of the sciences?
- Does this world-view remain an open system – open to continuous research and to the solution of possible conflicts through dialogue between the individual sciences and the philosophical system?

The Group also noted a practical problem: Conflicts arise between different interests and values, which are not easy to resolve. Can a socialist democracy be open to the new tasks which arise from new technical developments?

There are also conflicts of interests in social planning, and the setting of priorities must be open to change as new tasks arise from new technical developments.

On the question of human creativity Group A noted that there are two fundamental differences between the Christian and the Marxist understanding of Creation and Creativity. The first is the Christian belief in the ongoing redemptive activity of God which sustains, redeems and guides the universe. The second is the Christian belief that the final fulfilment of the created order is not necessarily continuous with historical development; it is something which God brings about in his own way at the end, an end which affects historical development and which incorporates historical reality by reconstituting it. This is what is meant by eschatological fulfilment. The Group affirmed that Christians should explain these beliefs to Marxists, because they are fundamental to the Christian understanding of Nature. At the same time, and despite these differences, the possibilities of mutually acceptable understandings of concepts like creativity should be explored and misunderstandings overcome. For example, the Christian does not understand the created order as a fixed reality already completed. It is to be seen as a dynamic changing order in which humanity is both a part and a transforming agent. However, creativity is not viewed as an exclusively human activity. Reality is itself in creative evolution and has brought to birth a large variety of beings and things which interact with each other.

The Group was agreed that the human element as a creative agent within the biosphere becomes a growing source of danger to the ecological balance as humanity's power is increased through science and technology. This power upsets the ecological balance necessary for sustaining human life and creativity. At the same time this increase in knowledge and skill enables humanity to construct a social order which would make it possible for every person to live a life of human dignity. Human creativity thus becomes decisive for the welfare of man. In this connection the Group affirmed that all labour should be regarded as creative and not science and art alone. Moreover, individual scientific and artistic creativity needs to be socially oriented in order to facilitate the greater creativity of all people as organized in society. It was said that "the organization of creativity thus becomes the task of political economy. Both freedom and order are necessary for creativity."

The Group suggested a number of general criteria for determining the goals of a true political and economic ordering of creativity: that it serves basic human needs, does not lead to oppression, maintains the ecological balance of the biosphere, and protects the life of future generations.

The Group also raised some questions:

1. Can creativity be planned? Or is it only received?
2. What is the relation between creativity and suffering?
3. God in his Creation had satisfaction (viewing it as good) and gave expression to himself (spoke the word) and rested after Creation (Sabbath). How do we incorporate these ideas into human creativity?

Finally, the Group called attention to a number of problems: of work in technologically organized societies; of the growing complexity of life and the need for more participation. This posed the essential paradox of technologically organized societies: in order to serve humanity such specialized and organized life requires responsible participation, political direction and control. At the same time, people are involved in political and technological processes which the majority cannot grasp and shape, because they lack the information, technical competence and ability to assess these processes. The Group concluded by asking, "How can control over these processes be effectively organized through an interplay of scientific-technical expertise, popular political decision-making and public opinion? For example, can we overcome the dependence of people on the "expert" and create an "expertise of all people" as a secular counterpart to the "priesthood of all believers"?

Working Group B, after reviewing the expert scientific testimony presented to the Consultation about the ways in which socialist societies are today redefining objectives in light of ecological challenges, posed the question, how might Christians and Churches in these countries contribute to this task? The conclusion was that they have a variety of opportunities to make their witness and to contribute to the public discussion.

They can speak, from their faith, of certain values that are common to Christians and non-Christians. For example, while they are concerned with the material welfare of people, they can emphasize that the raising of the material standard of living in the socialist countries of Europe is not in itself a sufficient goal.

In this context the Group called attention to five characteristics of socialism which can contribute to the realization of a just, participatory and sustainable society:

- The consciousness of the ecological problem that is inherent in historical and dialectical materialism;
- the integration of science and technology into social, political and ethical responsibility;
- the socialist way of life as a programme for the comprehensive and not only the material fulfilment of humanity;
- the possibility of national and international planning for the realization of ecological aims;
- proletarian internationalism as a programme of social justice in world-wide solidarity with the oppressed and exploited.

Reflecting on these positive aspects of socialism the Group identified four other issues that call for "continuing concern and investigation".

1. The ecological challenge calls for a kind of planning that has not yet been adequately developed by human societies. In the market systems that prevail in many societies, uncoordinated planning of various corporations and governmental units has not proved adequate to the needs of ecologically sound planning. Socialist societies incorporate provisions for central long-range planning. The system of democratic centralism has the aim of encouraging planning that rises out of the needs of the people and remains responsive to the people. But the question exists as to whether people, including Christians, can be encouraged to make sufficient use of the opportunities for participation, and whether systems of participation can be made more effective.

2. Christians are challenged not only to see the problems of environment, but also to relate these to their reviews of humanity, as individuals and within society. The socialist vision sees the economic order as the servant of human needs. It is increasingly obvious that no economy can meet all human material desires. Greed for money, for power and for richness or luxury does not know quantitative limits. But hunger can be appeased, cold relieved, the need for social security met. Marxists are redefining their vision of meeting material, cultural and spiritual needs in the changing historical context. At the same time Christians are redefining their position. The activation of public opinion in socialist countries offers an approach for the implementation of moral concepts in society.

3. Social systems often face the question of the responsible relationship between social justice, economic productivity and ecological responsibility. The realization that productivity is not limitless makes more important the just distribution of goods. A people hungry for food and freedom from exploitation cannot give much thought to the sustainability of a system that hurts them; their need makes more intolerable the waste and recklessness of those who have more than enough. Justice makes it imperative that social systems restrain irresponsible behaviour in all centres of power. Corporations (national or transnational) have no right to reap profits from ecologically destructive actions. Nations have no right to pursue their own economic advantage by rash consumption of imported resources or by the export (via atmosphere, waterways and foreign investment) of pollution. But the more the concern attaches to an entire society (rather than a privileged few within it) and to world society, the closer do the economically and ecologically desirable come together. The socialist concern for the whole society and the international society can be helpful at this point and calls for major changes in present economic practices.

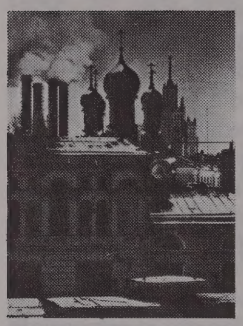
4. The time-frame for planning and action affects all societies. Many a programme for consumption of natural resources or management of wastes will be feasible or tolerable for five years but not for twenty, or for twenty years but not for a century. Although the best human foresight is limited, new ecological understanding makes people more aware of the dangers that present practice imposes on future generations. Have any of the world's social systems been sufficiently sensitive to such issues? Parents will sometimes restrain their desires for the sake of their children and grandchildren. But will any society practice severe restraints – especially when it sees a wasteful world around it – for the sake of people whom it will never see? Christians can encourage socialism in the transfer of concern from privileged classes to the whole society, from national societies to global society, and from contemporary society to a society that includes generations to come.

Recommendations to the Organizers of the World Conference on Faith, Science and the Future

The Consultation concluded by recommending that the programme for the World Conference in July 1979 should give attention to the following topics:

1. Information from socialist countries about a scientific approach to the successful solution of environmental problems through planning measures.
2. Presentation of practical experiences in the field of environmental problems in Eastern Europe.
3. A discussion of international cooperation of countries with different social systems for the solution of environmental and economic problems, including international cooperation in sharing of technology.
4. Contribution of the ecumenical community for redefining the criteria for human needs.
5. The application of socialist experience and theory to world problems of resource sharing, international technological sharing and the solution of environmental problems for a sustainable society.

Paul Abrecht



CHRISTIANS IN A SOCIALIST SOCIETY – THEIR RESPONSIBILITY FOR THE ENVIRONMENT AND THE FUTURE OF HUMANITY

(A Study Paper from the Church and Society Committee of the Federation of Evangelical Churches, German Democratic Republic) *

I. OUTLINE OF THE SOCIAL SITUATION

The problem of human survival is a global one. But, within this global perspective, we have to assume our responsibilities in the society and in the Church to which we belong. In this first section, therefore, we try to outline the situation in our own society, looking at five aspects which strike us as being relevant to the problem of human survival. While we realize that any such picture is bound to be fragmentary, we believe we have avoided any undue distortion.

A. Political and Economic Aspects

Public social activities in the field of ecology are determined in the GDR by the fundamental law of socialism with its fundamental claim: "The immediate goal of socialist production is progressively to satisfy the growing material and cultural needs of the people."

On this basis, the principal task for the present time was established by the main political party, the Socialist Unity Party (SED), at its VIIIth Party Congress in the following terms:

> "The principal task of the Five-Year Plan is to ensure a continuing rise in the material and cultural living standards of the people on the basis of a high growth-rate in socialist production, greater efficiency, scientific and technological progress and increased labour productivity."[1]

These political and economic aims and the priority assigned to political criteria over against economic criteria in the GDR have a bearing on ecological problems and their solution. Central direction and long-term planning make it possible to take ecological aspects comprehensively into account. This is reflected both in legislation and regulations and in social concepts and plans. To a much greater extent than in many non-socialist societies, private interests are subordinated to social interests. Limits to this appear when political or technological barriers or economic boundaries need to be crossed. For example, currency restrictions prevent licenses from being obtained for the importation of special processes or machinery (e.g. for importing air-filter plants, certain active carbon materials, high temperature combustion plants etc.). This equally applies to investments and outlay from state or local budgets. Activities in the ecological field are to this extent a compromise between the overall aims of society as a whole and what is actually possible. The education of the individual citizen's ecological conscience takes place in the magnetic field between individual responsibility and central planning. The complexity and difficulty of the process of conscientization in face of political, economic and technological factors which the individual cannot influence, are recognized and need to be offset by measures to foster political education.

B. Legal Aspects

Ecological objectives and policy guidelines are to a large extent written into the laws, statutes and regulations of the GDR. The Constitution sets out the fundamental rules, both for society as a whole and for its individual citizens, in particular with respect to land use, natural conservation, water supply, air, plant and animal life. The field of ecology is dealt with in detail in the directives of the GDR Land Utilization Law.[2] It prescribes precise rules, limits and procedures which afford a good basis for the achievement of ecological objectives. Among many other things, it includes special regulations concerning such matters as the recycling of waste, noise abatement, air pollution and so on, which are also legally tied in with other legal provisions dealing, for example, with planning permission, location of sewage outlets, etc. Where the regulations contain detailed concrete specifications (e.g. concerning exhaust levels in the case of internal combustion engines) they are often very strict in their defence of the environment and bear comparison with those of other countries. Existing legislation contains basic legal requirements for the various aspects of social and individual life, both now and in the future. But the lack of correspond-

---

* The Church and Society Committee of the Federation of Evangelical Churches in the German Democratic Republic (GDR) has been studying this theme for two years.

The Conference of Evangelical Church Boards, at its 50th meeting on September 9th and 10th 1977, asked the Committee to prepare a study paper on the subject for the Consultation on "The Contribution of the Churches in the Socialist Countries of Europe to the World Council of Churches' Programme on Faith, Science and the Future".

The paper was duly presented at the Consultation, held in Erfurt from August 23rd to 27th 1978. It was then revised by the Committee in the light of discussions at the Consultation and the final version completed on October 31st 1978.

ing economic guarantees to back up environmental measures reduces the effect of legal provisions in this field quite appreciably, since exceptions are made and permits granted which depart from the basic standards. The granting of special permits is often detrimental because it means that the necessary minimum requirements are also not met.

In specific cases where damage has been done by industries or individual citizens, the Law provides for disciplinary penalties and punishments to be imposed. In actual practice, we note, for example, that the National Contract Arbitration Tribunal, which is responsible to the Council of Ministers of the GDR, in its rulings in arbitration proceedings, imposes sanctions for breaches of the law (for example, it insists that the offender should cease polluting the environment, or be fined). The effectiveness of this sanctions system is often considerably diminished because industrial concerns or individual citizens pay the statutory fine imposed by the court but fail to take steps to remedy the damage done, objecting, for example, that they lack the necessary capital for such an investment or quite simply that the capital outlay involved bears no comparison with the amount of the fine imposed.

Responsibility for the overall coordination in this field is borne primarily by the Ministry charged with the protection of the environment and water supplies, which is directly responsible to the Council of Ministers.[3] Particularly important are the permanent inspectorates (e.g. the Standards, Weights and Measures Office, the Technical Supervisory Board, State Water Boards, etc.), since breaches of the regulations can be drawn to their attention and they have power to investigate them.

C. The Psychological Aspect

Problems relating to the environment and the future have been widely covered in press, radio and television since the early sixties. But the media have concentrated mainly on reporting individual facts without making it sufficiently clear how they are all interrelated. The consequence is that people are informed of the problem and realize that it exists but are often confused by the welter of unrelated facts which creates a feeling of impotence or fear.

Competition between the socialist social system and the capitalist social system stimulates the drive for economic growth. Influenced by western standards of consumption, popular expectations exert a certain pressure on the government to raise living standards. The value of the social system is largely judged by its economic productivity and its capacity to meet consumer requirements. It seems that people are not yet willing to accept ecological arguments or justice for the Third World as sufficient grounds for making material sacrifices or even accepting a slower growth rate.

Social-psychological factors such as these prompted the VIIIth Party Congress of the SED to formulate and adopt the description of its principal task to which reference was made in 1.A above. This explains why propaganda and the mass media give pride of place to increased efficiency and productivity rather than to conscientization on ecological issues. In consequence, environmental problems have arisen akin to those generated by conditions in industrial societies generally.

But if the individual citizen is to be stirred from his general apathy and bewilderment and to develop an awareness of the environment and a concern for the future, the impulsions and motives deriving from the imponderable ideals and goals of socialism are needed. The important thing in the socialist approach to ecology is that the purpose of production here is to benefit the society of producers and not just to benefit capital. This approach should also be applied ecologically. We need a critical study of the human needs which production is intended to serve. The ecological problems need structural solutions since they cannot be solved simply at the level of individual behaviour. But the possibilities available here need to be more fully analysed, made more easily accessible and widely known to the general public, so that people may be able to share responsibly in efforts to find solutions to the problems at all social levels.

D. The Scientific Aspect

Ecology, the study of the interrelationship between organisms and their environment, examines these interactions and tries to discern their regularities.

It is noticeable in the GDR that ecological problems are commanding increasing attention in the individual sciences.

Ecology demonstrates the inadequacy of studying the strain on the ecosystem, or its maximum load, from one single perspective in accordance with the traditional maxim of "one cause – one effect". Scientists are abandoning this idea and adopting a concept based on the maxim "many causes – many effects". This is essential, for example, in assessing the toxicological factors which represent a danger for human beings. Basically, for most pollutants, a causal connection between action over a long period and a toxic effect is demonstrable only by experiments under complete laboratory conditions. Whereas in other branches of biological science, one looks for and analyses real states and changes in them, what has to be investigated in environmental toxicology is the failure of changes to appear. This is something new for the natural sciences. One consequence of the limited predictive capacity of epidemological methods and animal experiments is that it is still impossible to quantify with sufficient accuracy the long-term effects of small and minute concentrations of potentially toxic environmental substances on broad sections of the population. This inability to assess with any certainty is not only a feature of environmental toxicology but affects many other branches of environmental research as well. A focal point of scientific study in environmental research in the GDR is the establishment of primary protection standards, i.e. the limits at which the potentially harmful substance can still be tolerated by human beings. This makes it necessary to establish working limits for specific environmental elements such as water, air and food. Such limits are designed to ensure that where primary protection standards exist they are not transgressed. Examples: threshold limit values (TVL)[4] and maximum permissible industrial concentrations,[5] drinking-water standards and limits of tolerance to food-contaminants.

The establishment of threshold limits is an essential preliminary if detailed specifications are to be laid down for the supervision and control of the environment and measures to protect the environment implemented. Working limits of this kind are established in the GDR by the Ministry for the Environment and Water Supplies, with its specialized departments: the Central Institute for Occupational Health, the Research Institute for Environmental Planning attached to the GDR's Academy of Sciences, and other institutions. Close working relationships are being developed with the other countries represented in the Mutual Economic Aid Council and the World Health Organization with the object of exchanging information and experience, so that measurement and evaluation methods can be standardized and agreed working limits established.

A perennial problem, of course, is how to introduce scientific findings into social practice.

E. Ideological Aspects

1. *Starting-Point in Classic Marxism*

In his critique of idealism, the young Marx envisaged in outline the reconciliation of man and nature by the complete naturalization of man and the complete humanization of nature.[6]

In his critique of capitalist society Marx identified not only "man's exploitation of man" but also the problem of the exploitation of nature, a problem which is inseparable from capitalism. "Capitalist production develops technology and combines a number of different processes into a social unity only by sapping the original sources of all wealth – the soil and the labourer".[7] Marx attributes the inordinate exploitation of raw materials and labour to the autonomy of capital. Capital produces for itself, and therefore according to no plan and without any reference to human beings and their needs.[8] According to classic Marxism, this problem would be eradicated by the hoped-for socially-organized system of production geared to human needs, replacing the "anarchical" production of the capitalist system.[9] It looks to socialism to eradicate the contradiction in capitalism between "the economic rationality of action in *part* of the system and the achievement of rationality in the *whole* system".[10]

2. *An Ethics of Science*

Marxist social-science recognizes that science and technology have common interests and seeks to subordinate them to society's responsibility for human beings. Socialism claims to have solved this problem and to have reconciled technological rationality and humanist rationality. A one-sided explanation is given of the ambivalence of science and technology, namely, that this is due to social circumstances. Any extension of political economy and its critique to include a critique of the rationality of means is rejected.[11] All the contradictions still existing under socialism and all its negative consequences are attributed either to capitalistic attitudes and modes of production or to temporarily inadequate scientific and technological solutions.

The sciences are integrated within the structured Marxist-Leninist world-view, which is convinced that it is *the* scientific world-view. An unimpaired faith in science in characteristic of the world-view. A high value is attached to being "scientific"; indeed, it almost acquires the status of a moral criterion. The scientific way of viewing reality is considered as the only adequate, objective, and reliable one.

3. *Ecological Crisis and Convergence Theory*

Talk of an ecological "crisis" is rejected. The term "crisis" is reserved for the relevant phenomena in the capitalist economic system. Although certain forms of "ecological danger" certainly exist under socialism, so that measures to protect the environment have to be organized by the State, a distinction is made between the nature of the danger under socialism and that under the capitalist system. Under capitalism the danger arises inevitably from the system, whereas under socialism it is no more than a symptom of an as-yet inadequate knowledge and application of social laws.

The term "ecological crisis" with its universal reference is dismissed as inapplicable. Its popularization is said to rest on a re-edition of the convergence theory which tries to play down the social differences between capitalism and socialism. It is one expression of the ideological struggle conducted by the capitalist countries in order to divert attention from their economic crisis by depicting the socialist countries as equally prone to crises.

4. *Link-up with Growth Theory*

In response to the first report of the Club of Rome, the need to reduce economic growth under socialism, and even the possibility of doing so, is denied. "In view of the high growth rate and the increasing prosperity of the workers, resources for protecting the environment can only be procured by increasing productive efficiency."[12] The GDR Law on Land Use (par. 3.2) also regards it as an urgent task "to ensure the continuous growth of the economy... and to improve the working and living conditions of the citizens". Ideologically, the ideal of the communist society as an affluent society ("from each according to his capacities, to each according to his needs") is widely held. There is little critical analysis of the evolution of needs and the way it conflicts with the limited ecological choices and the demands of global justice.

On the other hand, it is emphasized that "production" should be shifted more to areas of spiritual and cultural need. This is increasingly in accord with the socialist development of needs and can oust immoderate production simply for the sake of profit. In contrast to this, it is said, the capitalist mode of production cannot do other than "stimulate those needs of the workers which can enhance capital".[13] The "unity of the economy and social policy", on which so much stress has been laid since the IXth SED Party Congress, is meant to illustrate the difference between capitalist and socialist theories of growth.

5. *Optimistic Attitude to Life*

The treatment of ecological problems in the mass media and in society in the GDR rests on the conviction that historical developments at the world level are ushering in the age of socialism communism, when society will possess all the necessary means to be able to meet this challenge successfully. The "optimistic attitude to life" plays an important part in Marxist ideology here. It is an affirmation that what confronts us is not blind fate but simply the consequences of our own doing. Marxist ideology is convinced that, under the leadership of the party of the working class, society can take this and all other problems firmly in hand.

As Christians we must try to understand this attitude. In substance it is certainly more than *a summons to human responsibility* for the condition of the world which we have to hand on to future generations. This concern also leads to an essentially different treatment of the problem, to be found, for example, in specialized scientific journals. For people acting on socialist principles, any "apocalyptic mood" of doom is quite out of the question. The guiding light remains the Marxian vision of the future reintegration of man, when the "metabolism" between man and nature will (once again) be complete. Here again we are confronted with a conviction which perhaps reduces and is bound to reduce the urgency of the technological and economic problems facing the world. On the other hand, the mere recording of the facts – without any ethical motivation – could encourage a mood of resignation such as we already find in many parts of the world, even sometimes in our own society. That cannot be right for us. "The optimism that is will for the future should never be despised, even if it is proved wrong a hundred times; it is health and vitality and the sick man has no business to impugn it."[14]

In evangelical theology, therefore, we will constantly need to distinguish between the formulas used and their underlying intention.

F. Summary

Analyzing the situation from an ecological standpoint, we see that it has different aspects and has to be judged

with discrimination. A rational approach to ecology has many positive allies in the social system and in social realities. These should be drawn out and developed. But it also comes up against obstacles and countering factors which need to be surmounted. It is therefore an open situation and the decisive factor will be the general background against which we perceive the problem, our responsibility and the future.

That points to important problem areas in which Christian witness and Christian service are called for.

II. WAYS IN WHICH CHRISTIANS INTERPRET THE SURVIVAL CRISIS

The threatening ecological crisis raises questions and problems which are without parallel in history so far, and this baffles and confuses us. The *Menetekel* written warningly on the wall in the form of crisis symptoms and scientific prognostics needs prophetic interpretation (cf. Daniel 5). What is God trying to tell us in these enigmatic words? The Christian community tries to interpret the ambiguous language of the contemporary situation in the light of its traditional faith. In the process traditional interpretative patterns are also applied superficially and illegitimately. These patterns certainly contain elements of truth but are misleading. In church and theology we meet with three such patterns of interpretation which must be discarded.

A. Science and Technology as the Work of the Devil: the Overhanging Threat to Survival as an Inescapable Apocalyptic Judgement and Punishment.

The ecological survival crisis hanging over us confirms a deep religious distrust of science and technology. Ever since the Enlightenment, Science and technology have been felt to be an assault on the Christian faith. This feeling is strengthened in socialist societies where atheism is propagated all the more intensely because it is considered scientific. The scientific view of the world and the technological control of the world are, from a religious perspective, seen as a form of godlessness and as an expression of the pride that precedes a fall. By manipulating and reshaping the world with technology, man is arrogantly usurping God's place and assuming control of the world. The slogan: "Without God and sunshine, we bring in the harvest!" was felt to be a popular expression of this attitude. The more incomprehensible technological processes become to the uninitiated, the stronger becomes the feeling that technology is something sinister, menacing, and oppressive. The Tower of Babel provides the interpretative biblical symbol.

This attitude is becoming more and more difficult to explain in rational terms and, with the constant expansion of technological education, it is also becoming much rarer. Yet as a basic mood it still remains widespread. The crisis of the scientific and technological world can thus be taken as confirming a faith which never creatively assimilated the challenge presented to it by the Enlightenment and now finds its refusal to accept modernity justified.

It was possible, therefore, for this tendency to identify the survival crisis with apocalyptic predictions of the end of the world to grow, especially in fundamentalist circles. The danger of an apocalyptic dualism which takes refuge from the *aporia* of world history in an otherworldly hope, abandoning a salvationless world for a worldless salvation, looms up once more. This form of piety is sometimes combined with nostalgic moods and a transcendentalist religiosity.

The practical consequence is a refusal to share intellectual effort or to assume any responsibility with others, because of a pessimistic rejection of the world.

Paradoxically, those who adopt this attitude nevertheless at the same time enjoy the fruits of science and technology. However the summons away from the world dominates their testimony.

B. Complete Confidence that the World Can Be Controlled and Will Last

This second attitude, certainly far more widespread than the one described above, finds support in modern theology. Scientific and historical study of the Bible has shown that the alleged conflict between belief in creation and the natural sciences is an unreal one. Both systematic theology and scientific theory have taught us to differentiate between atheistic views and scientific knowledge. The modern secularization of the world in the name of science and technology became acceptable to and was adopted by theologians on the basis of the divine mandate to humanity to rule creation (Gen.1:26). This view has largely prevailed in the Church's catechetics and adult education. The ambivalence of science and technology is not always fully appreciated here. An undialectic acceptance of secularization is combined with the scientific and technological optimism which is deliberately fostered in socialist society. Any restriction of scientific research and technological production at the behest of faith seems unthinkable since this would be interpreted as a relapse on the Church's part, a retreat into its former lamentable hostility to science in a vain attempt to impose artificial and extraneous limits on scientific and technological progress. Scientists and technologists will soon come up with the answers and make new discoveries which will solve even the problems we have made for ourselves!

In this dangerous contemporary crisis and with our enhanced sense of responsibility for the future, some relief is afforded by the vague religious conviction that the maintenance of the world is ultimately outside human control and is guaranteed by God's faithfulness as Creator (cf. Gen.8:22). So far as the future is concerned, the Christian conscience is guided above all by the injunction: "Be not anxious!" A pious Christian maxim ends with the words: "... and leave the future to God!" To concentrate on the present as the time of God's presence and command and as the moment for the decision of faith seems to be what the Bible demands and an attitude which has been inflated by an existentialist eschatology.[15]

C. Faith and the World of Science and Technology Exist Unrelated Side by Side

At a Church and Society consultation the question was raised by the scientists: "What do we need theology for in the area of ecological problems? We know what the problems are by our scientific expertise, and their solution can only be arrived at by science anm technology." This is a widespread attitude. The self-sufficiency of the scientific approach is reinforced by Marxism-Leninism which claims to be perfectly familiar with even the ethical problems of science and to be in a position to solve them by its scientific knowledge of society.

The dilemma presented to us by theology and the natural sciences is not that between two conflicting because contradictory positions but that between two coexisting but unrelated positions, where there is no conflict because there is no connection.

The roots of this dilemma in modern Protestant theology can be traced back to the liberal theology at about the turn of the century. This was "deeply impressed by the immanent dynamic generated by the dominant forces of the industrial era – science, technology and a capitalist economy".[16]

A representative spokesman here is Wilhelm Herrmann: "The knowledge that every observable event is in practice regarded by us as subject to certain laws is an intolerable burden to us." "Anyone who looks at reality in the light of scientific knowledge is bound in the end to feel himself practically buried in the world." But, over against this, there is another reality, that of the "individual vitality of the individual, which exists only for the individual". "This distinction is of fundamental importance for the advocacy of religion today."[17] The response of liberal theology in Germany to the industrial revolution, therefore, was to abandon the world to its scientifically demonstrable autonomy and to restrict the Christian faith to the realm of inwardness and personal convictions. This fatal reinterpretation of the two kingdoms doctrine, turning it into a doctrine of two divided realms, was one consequence, by no means the least, of theology's failure to assimilate the scientific and technological revolution.

In what really mattered, not even the theology influenced by personalism and existentialism led any further than this.[18] On the basis of the claim of Jesus Christ to the whole of our life, Karl Barth and his school challenged the autonomy thesis. But this claim of Jesus Christ to the whole of our life can only be validated in a scientific and technological world if theologians enter into dialogue with the natural sciences and technology, and here we also find a gap, even in Karl Barth.[19]

In recent evangelical theology the doctrine of creation has been influenced by the almost unanimous view of biblical scholars and dogmatic theologians that the biblical witness concerning the Creator and his creation must be understood as based on and pointing to the divine revelation in salvation history. But this also brought with it the danger of concentrating exclusively on salvation history and relegating the biblical view of the world, with its relevance for our present dealings with the world, to the margin;[20] the danger of classifying the theology of creation with the human sciences while at the same time losing contact with the natural sciences.

The practical consequences of this attitude are: the Church and Christians must respect the scientific, technological and political experts and not interfere with their work; what faith contributes is the intellectual virtue of objectivity, the realization that the autonomy of scientific research and technological production is to be respected and not subjected to extraneous conditions. The Christian proves to be an exemplary worker and loyal colleague. Being a Christian and exercising a profession, moreover, are two separate roles.

III. TASKS ON WHICH THEOLOGY SHOULD CONCENTRATE

"The deterioration of the environment and the growing pressure on resources pose the question whether the extreme limits of the planet's physical integrity are not at risk. We must also realize that the population of the world will double in the next thirty years" (UN Specialist Conference on "Models of the Use of Resources and Strategies for Environment and Development").[21]

"It is my belief that our previous perception of reality is being so radically challenged by the world crisis now before us, which profoundly threatens the continuance of all highly developed forms of life, that everything on which we have previously been able to rely with confidence is now up for review" (A.M. Klaus Müller).[22]

The ecological crisis, as a result of which "everything on which we have previously been able to rely with confidence is now up for review", also represents, of course, a radical challenge (i.e. one which goes to the very roots) to the theological view of *creation*, the *future*, and *responsibility for the world*.

In what follows we shall try to draw out these radical questions.

A. Creation in the Context of the Ecological Debate

The development of the modern world picture rests on the distinction between subject and object. Man (the knowing subject) stands over against the world (the object to be known) and in the act of knowledge experiences his humanity; *"cogito, ergo sum"* (Descartes). This distinction had far reaching consequences. On the one hand, it ensured the triumphal march of the natural sciences and, in consequence, that of modern technology as well (including biotechnology, mental technology and management technology). On the other hand, it separated man from his roots in nature, made him a stranger to his own nature. Of course, neither the triumphal march of the natural sciences nor that of technology can be reversed. Without modern technology, millions of human beings would inevitably die. The cultural pessimism which regards science and technology as the work of the devil (see II.A) cannot therefore be the final answer to these radical questions.

But probing questions must also be put to the attitude of brash confidence in the creative potentiality of the world (see II.B). Modern rationalism's interpretation of the world naively equates what is knowable with what is real. "What is rational is real; what is real is rational" (Hegel).[23] It was only a short step from this to the materialist equation of knowability and feasibility. Because everything seemed knowable, everything had also to be feasible. The objectification of nature – over against man – which accompanied this degraded the natural world to the status of a mere store-room for humanity.

The systematic exploitation of the resources accumulated in nature by long evolution not only brought the exhaustion of raw materials dnagerously close but also turned man himself, to the extent that he is a part of nature, into a scientific object. Genetic manipulation, the artificial control of evolution, the deliberate simulation of human activities, and the military plans to annihilate the (still imaginary) enemy – all these are only illustrations of the fact that the objectification of nature also turns man himself into an object and in the last analysis makes him vulnerable to the manipulations of the (few) people who possess knowledge and power. Even the unquestioned subordination of the interests of the living and of future generations to the economy is an expression of that total science which is no longer pursued as part of a wider universe of meaning. Even the differences between war and peace are in danger of being obliterated. Peace has already become almost as dangerous to life as war (cf. the statistics for fatal road accidents with the figures for war casualties, and the environmental disasters with the devastation of nature as a result of wars; the prosecution of war and the destruction of the environment already coincided when herbicides were used in Vietnam).

Scientists today are therefore urgently looking for a new *comprehensive* scientific approach, one which calls a halt to the complete objectification of nature and reinserts nature in the history of humanity yet permits technology to be brought under the control, once more, of a humanity which acts responsibly.

But a theology which has accepted that faith and science should tolerantly go their separate ways cannot respond to natural science when it poses such radical questions. Compared with the abandonment of science and progress to the devil – we think, for example, of the trial of Galileo or the

reactions to Darwin's theory of evolution – the truce between theology and science was still the most acceptable solution for both parties. But the price theology paid for this truce was its abandonment of nature which was thereby subjected to the "autonomy" of natural laws and therefore to the experts. But the "God of the gaps" (Laplace) was bound to be needed less and less as the gaps in knowledge were closed, one after another. This initiated the retreat of theology from the world of facts. From then on the advance of science meant the decline of faith. The systematic concentration on the historic dimension and with it man's existence in the "kerygmatic theology" no more changed this situation than did the deliberate endorsement of technological progress by the theology of secularization. In both cases, science was abandoned to its freedom of research without any critical accompaniment at the level of specialized knowledge.

In fact, *a theology of creation or of nature* cannot possibly be achieved by returning to the models of the pre-scientific or pre-industrial age. Even the new theology of creation must not be purchased at the price of a new specialization of theology. The signature of the technological age is already far too deeply imprinted on contemporary academic theology itself, with its specialization and branches of expertise. We need to overcome the Cartesian division of the world into subject and object, being and consciousness, nature and history. "The division into subject and object does not exist in nature but in our minds – or only in nature to the extent that nature has also produced us and our minds. In nature there are not two things, but we see the same thing in two ways" (von Weizsäcker).[24]

Theology's answer to the challenge of science would be a comprehensive view of creation: nature and history are bound together in one creation. To confess that God is Creator is to put the whole world (nature and history) under his sovereignty. "To speak of God is to speak of the totality" (Claus Westermann).[25]

But on what basis should such a comprehensive theology be developed? The only basis we can regard as sufficiently solid – especially in the present situation of dialogue – is the historical revelation of God in the old covenant and in Jesus Christ. It is still true that "the Christian faith does not begin with the knowledge that God created heaven and earth, any more than does the faith of Israel. The first substantial thing which faith learns is that in the old conditions God creates new conditions" (Wolf Krötke).[26] We know that we are much indebted here to the main direction of recent evangelical theology. It is God's revelation in the salvation history which makes faith in creation accessible to us. In a world in which God is forgotten, with the metaphysical view of reality behind us, it is only faith which can confess that the world is to be regarded as God's creation. In a world threatened by nihilism, *faith* is confident that the creation has a meaning and a future because it owes its existence to the Creator's love and is destined for fulfilment. To achieve again a theology of nature there is no need to revert to a natural theology. The christological approach can lead us to a comprehensive theology.

It is essential, however, that this theology of creation, still to be developed, should seek interdisciplinary dialogue, be ready for dialogue and capable of dialogue. As partner with the other sciences, it bears its share of responsibility for the whole. Because of the dangers threatening the survival of nature and humanity, natural science and theology are "conflict partners in face of death".[27] The time of separate existence is definitely over for theology and the sciences!

A theology of creation of the kind we still need to develop would consider the question of scientific responsibility from the standpoint of the world as a totality. It would stick to its last, be speaking *theologically* and refraining from indulging in pseudo-scientific statements disguised as theology. But, leaving aside all false modesty, it would adopt a position in respect of the *totality of the world.* "In speaking of this great totality, the Old Testament speaks of God. If it were not to speak of this great totality, it would not be able to speak of God. God is related to everything that exists; everything that exists is related to God, for everything that exists is God's creation".[28]

A comprehensive theology would also have critical questions to put to scientific experts in the light of this totality. Not as an individual science but in the sense of a believing affirmation of the totality of the world. Then *man too, as a natural being* would once again take his rightful place in the theological analysis. This specifically includes his bodiliness, as scientifically studied in biology, his sexuality as analytically illuminated in recent times, and his behaviour, now an object of multidisciplinary research (cf. Gen.1:27f.; 2:24f.).

This would also make it possible once again to see the world as a totality in which "everything" is interrelated, as a complex system which, being an "open system"[29] despite the principle of causality operative within it, is not totally determined but open to accidents, a very fragile whole which cannot be endlessly imposed on and exploited.

Finally, it would be possible to think theologically again about the indivisibility of human responsibility. The choice before us is this: Either we shall have *one* world or we shall have *no* world; *one* humanity or *no* humanity! This is an appeal to man as *cooperator Dei* (God's co-worker). He is not only the shaper of the world but also its custodian; he not only rules as *homo faber* but is himself a creature subject to nature and shares in the groaning of the whole creation (Rom 8:11). With every other creature, he is subject to death.

B. Eschatology and the Future of the One World

The ecological crisis raises the question not only of the world itself as such but also of its future. This means that a theology of creation cannot be developed at the expense of a theology of history. The gloomy prognoses of environmental research seem to confirm the predictions of the apocalyptic biblical writers and to justify in retrospect the pessimistic forecasts of the early days of technological progress. What are we to say to this?

In the first place, the biblical tradition views history as an ambiguous process. Human history is, on the one hand, a history of sin. The story of humanity's "Fall" (Gen.3) is an impressive account of this aspect. The breach of fellowship with God leads to disorder in human relationships and all the conditions of life. Even the history of Israel is a story of sin and falling away from God. This line continues into the New Testament: "The whole godless world lies in the power of the evil one" (1 Jn.5:19). "For sin pays a wage and the wage is death" (Rom.6:23). Suffering and inevitable death are interpreted as signs of the imminent end of the world (Mt.24:23).

At the same time, we must note that this is not the Bible's last word on the future of the world and humanity. Already in the Old Testament, and still more in the New, we are pointed to the promise which embraces all creation. Even after the Fall, the promise still holds good: "While the earth lasts, seedtime and harvest, cold and heat, summer and winter, day and night, shall never cease" (Gen.8:22). Even after the destruction of human fellowship by hubris (Gen.11), a new promise is made, this time to the ancestor of a people, Abraham, and indirectly to all nations: "I will bless thee and thou shalt be a blessing" (Gen.12:2). Despite Israel's sin and failure, God's blessing continues to accompany this people. God escorts it throughout its history and

renews the covenant and the promises. He thus clears a way for his people through history and gives it a future.

This hope is even more in order on the basis of the new covenant established in Jesus of Nazareth, the Christ, and from then on embraces all humanity. Even now, the "old era" and the "new creation" still coexist in conflict. Already now, "when anyone is united to Christ, there is a new world (*ktisis*); the old order has gone and a new order has already begun" (2 Cor.5:17). But the other aspect has not yet been abolished: "faith is our guide; we do not see him (Christ)" (2 Cor.5:7). This tension between the "already now" and the "not yet" is "the basic question of eschatology" (W. Kreck).[30] This tension – with its biblical basis – rules out any one-sided condemnation of as well as any uncritical belief in progress. All things – the created world and human achievements, the given realities of nature and the glories of human civilization – are subject to the "eschatological proviso". They are not yet the "ultimate". Because of man, the curse lies on all that exists; but because of Christ, also a promise.

As part of creation, therefore, humanity, too, shares the "eager expectation" of the "created universe" (Rom. 8:19). But all children of God share in the promise of the coming kingdom and the "new creation" (Rev.21:1). Christ, the "firstfruits of the new creation" (1 Cor.15:20), establishes our hope but he directs his disciples to the way of discipleship. Along this way, they must "keep faith with history" (Nietzsche) and cannot bypass suffering. Along this way they acquire hope and a future; not the distant future of the beyond but the imminent future of God's kingdom. It is love which is the distinctive mark of this way, the love which regards the neighbour as more important than the distant future, whether it be the religious future, the planned future or the utopian future.

When love becomes the criterion also for the shaping of the future, the contours of a "worthy and defensible future" begin to emerge:

It is a future for human beings; one in which the suffering common to all can become a fellowship of solidarity and the quality of life is not measured exclusively in terms of what is quantitatively feasible nor the individual sacrificed to the dominant interest of the powerful. The ambivalence of all progress (blessing and curse) reminds us of the divided character of the world which suffers from man, the "divided being". Today, when progress is in danger of reaching unmanageable and therefore menacing proportions, when technology threatens to escape from its inventor's control, it is supremely important that we should be reminded that the universe is subject to the "eschatological proviso", that it belongs only to God, and that humanity is not at liberty to disturb the delicate balance of nature (creation) without serious consequences, if the future of humanity and the world is not to be jeopardized.

New elbow-room and promising possibilities are offered to us not by a refusal to act but by a controlled and responsible use of "means". Humanity shares with the Creator the responsibility of being concerned for the future of the created universe! This is precisely why there must be a check to unlimited progress. We have reached a point of crisis in human history when we have to decide between life and death.

The developing crisis in which we find ourselves is illustrated by the growing difficulty of distinguishing between war and peace. But in both cases the present threat to the future of the universe is caused by the supposed feasibility of the universe. Humanity has reached a point when Hegel's rational world order comes to an end. But the rationality of the humanly possible became suspect to us long ago. In the biological field it has long been asked whether it was desirable or rational to run the whole gamut of genetic possibilities. What is possible is not always rational as well!

Renunciation and the readiness, if need be, to suffer could therefore become signs of hope in a world, large parts of which are sick from compulsive consumerism and which dreams of an artificial world without death and pain, not recognizing that there can be no life without death.

Faced with this challenge from the future, torn between menace and hope, theology is both *questioned* and *called into question:*

> *"The destruction of history is... identical with the destruction of nature. It is not only the ecosystem which is being ploughed under but also the traditions. Real history is embedded in the natural evolution of the human environment. But in view of the fact that, for centuries now, theology has no longer been prepared to study this human environment seriously, we are compelled to ask on what basis it will ever have the right in the 20th century to speak of history in any sense whatever" (Georg Picht).*[31]

IV. TASKS ON WHICH SOCIAL ETHICS SHOULD CONCENTRATE

A. Ethical Criteria for a Sustainable Society

In face of the question of survival and durability, ethics should point us to "ways through danger" (C.Fr. von Weizsäcker) which can be travelled in "creative discipleship" (E. Wolf). In developing this ethics, the *starting point must be the totality of the world* and humanity must be seen as part of this totality (of nature, of society, of history).

To do this, ethics will need to become involved in scientific discussions and findings.

If ethics is to be able, in an "age without precedents" (W. Behrendt), to point the way, it will need to be developed *dynamically* and be *open-ended towards the future.* In contrast to a value ethics, it must be receptive to new developments, since values change. If scientific and technological processes are not to degenerate, a discussion of ends is essential.

If ethics is to point the way in a world of global interdependence, it must develop *ecumenically.* In a world which is, at one and the same time, one and culturally diverse, ethics needs to be developed both universally and contextually, it must arise from dialogue and be ready for dialogue.

1. Responsible Stewardship of Nature: from Exploitation to Cooperation[32]

The mandate to rule the earth (Gen.1:28) already appeared profoundly ambiguous even to the authors of the primal history presented in the Bible. On the one hand, it accords with God's rule as Creator and has his blessing; on the other hand, as oppression and subjugation, it is tainted by sin, so that humanity needs reminding of God's absolute and sovereign claim to all life (Gen.9:1-7; cf. Gen.1:26-29; 2:15). Only God's covenant fidelity towards all creatures preserves the created order, threatened by chaos and human sin, for its fulfilment in the eschatological peace of creation (Gen.8:21-22; 9:8ff.).

The ambivalence of man's relation to nature under the sign of the *dominium terrae* has been intensified by the cultural evolution in the direction of a scientific and technological world. Patterns in which humanity and nature interact are increasingly replaced in scientific technological culture by the habit of treating nature as exploitable material. At the same time, humanity becomes alienated from the natural environment and from its own nature by the predominance of an objectified nature.[33]

As a result of this the *dominium terrae* was secularized. It became detached from its living relationship to God the Creator, who binds humanity and nature together as fellow-creatures, and also from the context of hope and responsibility provided by the Kingdom of God which unites humanity and nature in hope and patience (Rom.8:18ff.). Humanity as subject now relates to nature solely as object and assesses its value in terms of its utility to man. For the most part, theology and piety were not strong enough to correct this deviation critically and constructively; indeed, under the banners of idealism, personalism or historicism, they tended to withdraw completely from any share in shaping the scientific and technological world.

A different approach is needed. On the basis of faith in God as Creator, in the light of the divine incarnation and the promised consummation of creation, we must develop criteria and perspectives for our dealings with nature in the scientific and technological world. Such a "practical theology of nature"[34] will also need to pick up certain of the concerns and truth-elements of dialectic materialism (see I.E). Accepting the realities of life in a scientific and technological civilization, it will have to develop these along truer lines. Its answer will not be "back to nature!" but rather "forward" to nature. Nostalgic dreams of a harmonious pre-technological world are illusory. So, too, is any rejection of the contemporary world. The Bible dreams of a liberated peaceful world, not by looking backward romantically to the past but by looking forward prophetically to the future (Is.11; Rom.8:18ff.). It is also aware of the continuing rift between humanity and nature (Gen.9:1ff.; Rom.8:22-24), which will only be healed when the Kingdom of God comes but which, within history, can be overcome only partially and parabolically. The eschatological peace between humanity and nature is subject to the eschatological proviso. Our hope in this eschatological peace allows us to accept the conditions and ambivalence of the scientific and technological world, soberly yet at the same time creatively, so that we can welcome changes and seek better and more natural ways of dealing with nature.

In other words, we human beings can see ourselves not only as standing over against nature but also as participating in it as fellow-creatures, and doing this as something inherently natural to us, and always remaining sensitive to the dialectical tension between co-creaturehood and dominion. This is possible when dominion over nature is enfolded in compassionate and hopeful solidarity with the creature, thus preventing dominion from degenerating into technocratic absolutism.

The scientific and technological style of processing and handling nature needs to be corrected at least by elements of interaction with nature. Ways must be found to move away from the exploitation of nature to "cooperation with nature". Hints as to what such a cooperative relationship with nature would look like are provided in the insights of quantum theory and information theory, where instead of a subject-object relationship we see an interaction between researching subject and researched object.[35] The relationship between humanity and nature would along these lines be understood and ordered in dynamic-system models as a community of open life-systems each with its own, happily diverse, subjectivities.[36] The call for new so-called "soft" technologies which are accommodated to the ecosystem points in the same direction. Ecology must be taken seriously as the boundary condition of all economy and a sense of stewardship and responsibility must control our use of nature.

2. Knowledge and Wisdom

One of the major contemporary issues is the inclusion of science and technology within our common responsibility for a humane world and its future. In other words, an ethics of science is needed. Ethics must therefore accept involvement in science and introduce its claims rationally and clearly into scientific work. Scientists must be willing to discuss the question of ends, which they are incapable of answering purely on their own presuppositions.

Marxism-Leninism offers a model for this: namely, the incorporation of the sciences into a world-view and the integration of science and technology as productive forces in economic policy.

Another current model might be called the "application ethics". Here, science and technology are regarded as autonomous and neutral in value. Ethical questions arise only when it is a matter of applying scientific findings and techniques.

Neither model does justice to the ambivalence of science and technology. This ambivalence lies in the fact that the very thing which makes them beneficial and useful also makes them noxious and dangerous.[37] Because of this ambivalence, it is essential to expose the assumptions and consequences of science and technology. Starting from the desire for a pure understanding of nature, science regards nature as an object and in doing so fosters the idea that nature is a disposable object. Both technology and society lay claim to science for their own purposes and use it as a productive force. Technology is interested in effects and so far has turned a blind eye to unintended side-effects and consequences. The increasing specialization of science makes it easier for technology to ignore these unintended side-effects, as is clear from the problems which ecology has with its methods. We need a science of the consequences of science! Its basic approach would not be *homo faber's* being as a "do-er" but the sensitivity of one who allows himself to be affected, the perception of suffering, compassion: in other words, the creative imagination of love.[38]

But this insight into the connection between deed and consequence is one of the basic themes of the wisdom literature of the Old Testament (cf. "People who set traps for others get caught themselves. People who start landslides get crushed", *Prov.* 26:27). It is not a "doctrine of retribution" which is offered here but the lesson of life that "by every evil deed or good deed a momentum is released which sooner or later also has an effect on the author of the deed".[39]

"Wisdom" is the alert perception of these interchanging connections; when we act we do not stand outside these connections but are on the contrary involved in them. This is the ecological relevance of "wisdom".

The modern habit is to link knowledge with power. The New Testament, in contrast to this, links knowledge and ability with the love which is willing to serve and to suffer. Jesus resists the temptation to absolute power (Mt.4:1ff.), devotes his power exclusively to the service of others and takes the path of suffering and compassion. "The all-important transformation which prepares us for compassion in the technological world, and the only one therefore which will make us capable of surviving at all, must take place in the subject!... Jesus, who himself suffered more than any other from our actions, ...enables us to see our actions from the standpoint of their victims and so sensitizes our consciences to see clearly the evil consequences which flow from us and our deeds..."[40]

Dealing with Christians who boast of their intellectual knowledge (*gnosis*) and unrestricted control over the de-divinized world (*exousia*), Paul insists that the test of knowledge of the crucified Lord is whether or not it serves the brother for whom Christ died (1 Cor.8:11). True knowledge and true power issue in responsible service.

3. Universal Responsibility

In our interdependent world parochial thinking is out of date. To think in terms of mutually exclusive alternatives has become mortally dangerous. It is now vital for survival to go beyond such oppositions. We have pasts in the plural, but a future only in the singular (J. Moltmann). At the same time as the contrasts between rich and poor deepen, the right to racial and cultural identity is affirmed in opposition to political tyranny and cultural alienation (self-reliance).

In such a situation, it is necessary that ethics should be developed simultaneously both at the universal level and contextually. For ethics in this sense, the fact and the future of the reconciliation in Christ provides the theological basis and approach. Such an ethics is both universal, in the sense that it transcends the barriers, and concrete, in so far as it sides with the oppressed and the weak.

Humanity, being both one and, at the same time, diverse and multiform, cannot achieve peace within the enforced structures of a centralized totalitarian world state, a universal technocracy, but only in open, dynamic structures of partnership and dialogue. Development must therefore be understood as liberation and training for independent and responsible partnership. Politically, this means moving from development aid via development policy to an economic and international world policy which assigns priority to the needs of the developing countries with all the consequences this will entail for domestic policies.

For socialism, the historical application of the socialist approach to this particular situation means working and striving for social justice for the oppressed peoples of the Third World. "Today the poor nations find themselves in the position the European worker was in in the 19th century. To be able to live he had to sell his labour for whatever he could get for it. With his wages he bought goods at prices fixed by the employer classes to suit their own interests. ... Socialist governments and parties in Europe must carry over into the international arena the struggle they have waged and continue to wage in their own countries for equal rights and opportunities. They must recognize that, viewed from the international angle, it is their nations which are the rich ones and the exploiters, and act accordingly" (Nyerere).

What universal responsibility calls for is open dialogue, not the imperviousness, isolation or aggressiveness of the monologue. Since all are concerned in this, all must take part in the dialogue: ideologies, religions, theological faculties, sciences. We must oppose the tendency to absolutize particular aspects and promote instead a dialogue in which each preserves its identity but also seeks agreements on viable common policies for humanity.

B. A New Focus on Quality of Life

The emphasis on quantitative economic growth has proved impossible ecologically and led to loss of meaning and crises of meaning.[41] But what do we mean by "quality of life", or, in socialist terminology, "the socialist way of life"? More is meant than merely coming to terms with the boundary conditions of the "limits to growth" and adding indicators such as "environmental quality" to the quantifiers by which quantitative growth is measured. Experience of the ambivalence of economic and industrial growth is such that it provokes a crisis of meaning. But behind every positive definition of "quality of life" there is a general idea of what gives life meaning. The indicators should translate these ideas into social and political objectives. But the most that can be provided in this way for the investment of human life with meaning are optimal *enabling* structures. The *discovery* of meaning takes place in the realm of "biographical experience" (Klaus Müller) and exceeds the reach of what can be structurally organized or created.

What view does Christian faith have of "quality of life"? The following aspects may be mentioned:

1. Life is essentially a gift of God, who being the absolute living One is the source of life (Deut.5:26; Ps. 36:10). Being the gift of God, life always remains in his gift. Though life is a human being's most intimate possession, it never becomes his absolute property. Being always already related to God, the human being is placed beyond his own absolute control.[43] To find himself he must go out of himself. Human life is essentially life in relationship. His relationship to God is matched by his relationship to the fellow human being and to the creation (Gen.1:26ff.). It is in these relationships, by conformity with them or contradiction of them, that the quality of life is decided. The fullness of human life can therefore never be measured by quantitative criteria. On the contrary, it is in these relationships and on the basis of these relationships that everything quantifiable derives its relative value.

2. In the presence of God, human beings learn to know themselves as those who have always already broken the relationship to God, to fellow human beings, and to the world, and therefore have dis-qualified their lives, robbed them of their truly human quality. This is the latent core of every experience of discord between people, and between people and nature. This latent core becomes manifest in the encounter with God, who takes the initiative in healing the broken relationship with humanity accepting them unconditionally in free mercy. Human life is qualified, given quality, by God's pardoning and renewing love. Human life means accepting and rejoicing in God's unconditional affirmation and love. Since the quality of life is to be interpreted in terms of our being loved by God, "being" has priority over "having" (E. Fromm) and "work". Self-realization, self-fulfilment, does not mean that we make our lives valuable by our work; it means that we can in freedom make use of, and in fact do make use of, the gifts bestowed on us, the gifts of creation and of the Spirit. Because people are loved for their own sake, the quality of life cannot be measured by utilitarian criteria. The appropriate response to being loved is disinterested joy and celebration, thanksgiving and praise. The provision of sufficient space for these things is therefore an indispensable part of the quality of life.

3. A shift of emphasis from quantity to quality of life, interpreted in the light of the Gospel, does not primarily mean, therefore, renunciation, sacrifice and asceticism. Demands of this kind are still on the level of moral postulates, and therefore, part of the law which directs people to qualify, give quality to, their life by their own efforts. The Gospel guides us into that receptive openness to a life given by God, a life in which renunciation and sacrifice are understood not as a contraction but rather as the fulfilment of life. The new life-style is not a legal demand but an evangelical gift. It is not squeezed out of us by the threat of the coming ecological disaster but grows naturally out of our rebirth to a living hope (1 Pet.1:3). Contemporary warnings of catastrophe are analogous to the preaching of John the Baptist, the ascetic figure from the desert who demands conversion in view of the impending catastrophe of judgement (Mt.3:7-10). Christian proclamation has to follow the way of John the Baptist to Jesus. Jesus summons to conversion in view of the Reign of God, which bestows joy and freedom for the new human life, based on the love which accepts us unconditionally and by doing so sets us free to love.

The law enforces outward conformity. The Spirit sets us free to follow freely the dictates of the heart, releases creative forces and awakens us to love's distinctive respon-

sibilities. The hard necessities of the ecological crisis will impose certain restrictions and economies of consumption on the abundant societies. But this will inevitably lead to frustrations, depressions and aggressions unless the alternative is offered of a rewarding life "not by bread alone", a life which inwardly liberates us so that we are able to renounce material blessings.

4. The quality of life is total and indivisible and is to be understood in the dialectic of history and eschatology.

God's saving activity is experienced as deliverance from bondage, the gift of the land, a blessing which takes the very concrete and quantifiable form of numerous progeny, herds of cattle and rich harvests. Good conditions are the fruit of the restored relationship to God. Salvation is embodied in prosperity, and prosperity has its spiritual dimension because it is a gift of God which is received with thanksgiving and used responsibly. But historical experiences of salvation and prosperity point beyond themselves to the eschatological fulfilment of the quality of life in the *shalom* of the Kingdom of God.

This totality and indivisibility have been denied in the history of the Church by a spiritualistic dualism hostile to the body, apocalyptic and world-renouncing. Over against this, Marxism and its critique of religion have stood for man's historical self-fulfilment in society. In this view religion was doomed to die out because what it promised as a fulfilled life was already being achieved in this world. But religion, instead of dying this good death, fulfilled, has continued for the most part to be immersed in a vulgar materialism which is now exhausting itself in endemic production and consumption. Dissatisfied with this lot, a new religiosity and transcendental pietism are gathering strength today which seems once again to be a movement of flight from the difficulties and responsibilities of history.

The anthropological question arises as to how man can live out this unity of self-realization and self-transcendence which matches his "structural openness to the world". The theological question is how the wholeness of salvation can be maintained in view of the distinction between and the inseparable unity of the "penultimate" and the "ultimate" (Bonhoeffer).

The answer is to be sought in the dialectic of eschatology and history, a dialectic rooted in the resurrection of the crucified saviour. By hope in the eschatological fulfilment which transcends history, we are in fact liberated to perceive history itself as the open-ended movement in the penultimate (Mt.6:33). Hope gives to life the quality, the dimension, of openness to the future. It sets us free from the anxiety which leads us to idolize the transitory in our fear of the future and in the belief that security lies this way. In fact this way leads us into alienation and closes us to the open possibilities of the future. Hope establishes in us the freedom of "having... as having not" (1 Cor.7:31). Hope breaks open the shell we have ourselves constructed against the future so that we and our hidebound conditions and relationships now become ready for historical changes.

But along the *via dolorosa* of the coming Lord and in the mission of his Church, the sovereignty of God is already anticipated in those whose quality of life is assailed and devastated. Hope takes the concrete practical form of solidarity with those who suffer for whom the resurrection of the crucified saviour has secured a future and hope.

5. Quality of Life is Achieved in Sacrificial Love

As the loving one who establishes fellowship and sacrifices himself for us in Jesus Christ, God is the source of life. The twofold command of love is therefore the *magna carta* of quality of life. Life can only be experienced in its fullness and intensity as we are responsive to and sacrifice ourselves for others. If we wish to hold on to our life and keep ourselves to ourselves, if we are too afraid of loss to live, too afraid of disappointment to love, then we forfeit our life. If we risk our lives and sacrifice ourselves, if we make ourselves vulnerable and actually suffer by sharing the life of another, then we find our life. This is the paradoxical "quality of life" made manifest in the ministry of Jesus Christ. Quality of life, therefore, includes the readiness and the capacity to suffer. Indifference, a life free from pain and conflict, is a temporal idol. But it is also a symptom of a psychological and social sickness which incapacitates us for fellowship.

C. Ways of Change

1. A Twofold Way: New Life-style and Structural Social Change

The threatening survival crisis calls for profound change both in individuals and in social aims and structures. In ecumenical discussion, two ways of meeting this twofold challenge are debated.

Individuals and groups are trying to change their life-style to one which does justice to ecological requirements and the demands of social justice at world level. Experimentally and symbolically, the new life-style anticipates the pattern of life which although still at present in conflict with customary behaviour patterns must in future become generalized if humanity is to survive.

By cooperating in society, efforts are made to influence its economic and political decisions so that these may help towards the achievement of a durable world society, capable of survival. This entails the use of the opportunities available for shaping public opinion in order to achieve majorities, to discover and use possibilities of change in the structures, and to work for and achieve promising compromises in the clash of economic, political and ecological interests.

There is a relationship of tension between these two models, as M. Lindquist has demonstrated in his account of the Futurum Project, where he presents this relationship of tension as one between a distinctive model and a participatory model: on the one hand, the creation of "prophetic communities": on the other, cooperation in existing institutions and groups; on the one hand, concern for radical change: on the other, concern with practicable change; on the one hand, protest and anticipation of the future: on the other, compromise and development of what exists, towards the future.[44] The two models of responsible action are both to be taken seriously. Each has points in its favour not covered by the other.

But the two models are mutually complementary. Each needs the other. This is already evident from the mutual interaction between individual change and structural change. From the standpoint of social psychology, human attitudes and behaviour patterns are intensely extrovert, and much less introvert and tradition-oriented (D. Riesmann). It is hardly possible for individuals on their own to escape collective trends and the influence of the mass media. To achieve the urgently needed behavioural changes in individuals, therefore, it is vital that influence should be brought to bear on general social trends. On the other hand, the policy of governments and the mass media depends on the support of the people and their expectations help in some measure to determine that policy. The shaping of opinion at the base level can therefore assume importance for political changes.

The "life-style" groups are evidence that the crisis of survival demands processes of change at the deepest levels of human life, processes which are not automatically produced by changed conditions. Political participation in the structures of society demonstrates that the crisis of survival demands

"love in the structures" and excludes any retreat into private inter-personal niches.

Isolated from each other, both models have hidden dangers. Life-style groups which consider themselves alternatives to society are in danger of ending up in a dualistic attitude which responds to the threatened world crisis by a rigoristic or passive separation from the world (cf. II.A and II.C). In sociological terms, such groups easily become elitist or marginal and politically irrelevant. That their commitment includes responsibility for the world must be made evident by their readiness for dialogue about the way of political participation and by their cooperation in the decision-making processes of society.

In the case of those who opt for participatory cooperation in society, the danger is that in their concern to reconcile opposing interests, in their efforts to carry conviction with all, and to achieve viable compromises, they may muffle the urgency of the problem and lose sight of the more far-reaching objectives. The effort to introduce the Christian faith into the decision-making processes of rational ecological policy can all too easily topple over into secularization, and faith lose its liberating power, the salt its savour. What is needed here, therefore, is alertness to critical questions and openness to changes, the willingness to face up to the question of ends and to ask political questions about the feasibility of what is needed, rather than retreating to the pragmatism of the "art of the possible".

2. *Possibilities for Cooperation in the Socialist Society of the GDR*

The social cooperation of Christians will be guided by the needs of a durable world society capable of survival. The decisive criterion for socialism as for every contemporary social system, is the contribution it makes or could make to this end. As they cooperate to make the contribution, therefore, Christians will try to apply the criteria mentioned above to particular cases. In doing this we can latch on to certain basic socialist positions:

- the built-in awareness of the ecological problem in dialectic materialism;
- the inclusion of science and technology in social, ethical and political responsibility;
- the "socialist way of life" as seeking the comprehensive and not merely materialistic fulfilment of human life;
- the possibilities of central long-term planning for the achievement of rational ecological policy;
- proletarian internationalism as a programme of solidarity with the oppressed and exploited in other lands.

For practical political effort, the national education law and the law on petitions mentioned earlier, are important instruments for the achievement of a rational ecological policy.

Over against that, there are certain facts and objectives of socialist society which to some extent are in a relationship of tension with the criteria of a durable world society capable of survival. Two of these are mentioned here:

- The priority given to economic factors over the ecological; industrial and economic growth is seen as the main task. A number of factors are at work here: needs of the people which ought to be met for political reasons, too; the raising of economic power; obligations to and participation in the RGW and in the world economy.
- The claim of Marxism-Leninism to be the true world-view and political ideology and the doctrine of the international class-struggle. Here the need is to demonstrate constantly a readiness for dialogue and to develop political coexistence into political cooperation, which is essential if humanity is to survive as the community it inescapably is.

While centralized democracy certainly makes it possible to devote long-term and comprehensive attention to ecological aspects, active participation on the part of the people needs to be fostered and the economic processes of society need to be made more intelligible in order to eliminate the sense of impotence and dependency and to stimulate the will to accept responsibility. Specific experiences show how much can be achieved in community and industrial bodies by personal effort and expertise, and the opportunities available for Christian influence are still not being fully exploited.[45]

In the development of a new life-style, small groups will have an important part to play. Individuals and even nuclear families need the stimulus, support and help of groups of like-minded people if they are to resist dominant trends, habits, needs and standards. Western patterns of residential or rural communities or cooperatives, which regard themselves as comprehensive communities, sharing their life, their production and consumption, are not possible in the GDR of course. The comprehensive centralized planning of social life and work leaves no room for this.

What Christian congregations can do, however, is to fill the role of such stimulating supportive groups. Members of the congregation are engaged in the ordinary daily life and work of society, they meet in house groups, married groups, family and youth groups, as well as learning the way of fellowship in group weekends and retreats. Here would be the place to consider and try out possible approaches to and elements in a new life style.

The following tasks would need to be given priority:

- *Information*

Specialized information relevant for decision-making needs to be explained in terms which non-specialists can understand. The withholding or "classification" of information for political or ideological reasons must be opposed.

- *Motivation*

Without motivation, information changes nothing. People in the congregations are tolerably well-informed about the facts of the ecological crisis. Yet this knowledge does not issue in action. Reasons for this may include: a sense of powerlessness in face of a political, social and technological system which is centrally directed and complex to the point of opacity, a feeling that "we certainly can't change anything"; helplessness ("we'll certainly never change our ways"); absence of any sense of direction ("what practical alternatives are there, anyway!?"). These attitudes cannot be effectively dealt with at the purely intellectual and moral level, i.e. by information, discussion and exhortation. They are located at a deeper level, one where Jesus' liberating call to repentance gets through and really changes people. If it be true that the new life-style is born of the joy and deliverance of the Gospel, this fact is also vitally important for the influence of such groups on their environment. They will only frighten people off instead of attracting them, if all they offer is indictments, legalistic demands, threats, instead of the positive alternative of an attractive and fruitful life based on the Gospel.[46] What should emanate from the "life-style" groups is not the cynical, ascetic and élitist spirit of a Diogenes of Sinope but the contagious joy, devotion and sacrifice of a Francis of Assisi.

- The development of sensitivity to the suffering of others and to future suffering, and training in solidarity as a way of life. Lazarus in his poverty is not at our gates, he does not force himself daily on our attention; he is the distant neighbour and the neighbour not yet born.

If he is to be a really decisive factor influencing our behaviour, he must be deliberately brought into our minds and feelings. For this our consciences need to be trained in love, and eagle-eyed love which can see and feel distant distress. We can learn to do this by overcoming the divisions which criss-cross our own society, e.g. between the healthy and the sick, between those able to work and the handicapped and disabled, etc.

- The development of sensitivity to the natural world around us; growth of a sense of our co-creaturehood, and of the need for responsible stewardship.
- The examination of our own needs and habits of consumption; taking steps which set an example of what focussing on quality of life means in practice.

These groups will also be able to encourage and equip individuals for cooperation in social and political tasks. They will be able to reexamine experiences of failure in efforts to make ecological sense prevail. When unavoidable compromises have to be made in the social and political sphere, the group can help to ensure that attention is focussed afresh and kept focussed on the mission and the goal.

In the socialist context, therefore, Christian commitment to efforts for a world society capable of surviving is imbued with the desire to cooperate in the contribution of socialist societies to the survival of humanity, both by positive action and by critical questioning. As minorities, the churches have little influence on the centres of power and decision. Their work will mainly be concentrated on the mission entrusted to them; namely, to summon men and women, in face of the menace of ecological disaster, to become converted to the Gospel future with its promise of life, and to order the life of their congregations so that it illustrates what that conversion means.

NOTES

1. Central Committee Report to the VIIIth SED Party Congress, presented by Comrade Erich Honecker, p. 38 (Dietz Verlag Berlin 1971).
2. Law on the planned development of socialist land use in the German Democratic Republic (*Landkulturgesetz*), 14th May 1970, published in the Legal Gazette of the GDR, Part 1, 1970, p. 67.
3. Statute of the Ministry for the Protection of the Environment and Water Resources, 23/10/75, Legal Gazette I, No. 43, p. 699.
4. Threshold limit values (*Inmissionskonzentrationen*): maximum permissible concentrations of substances which by polluting the atmosphere affect plants, animals and humans.
5. Maximum permissible concentrations in industrial zones (*maximale Arbeitsplatzkonzentrationen*): maximum permissible concentrations of substances injurious to health in the atmosphere in industrial zones; i.e. concentrations which, for a person working up to 8 hours a day over a whole working life, cannot cause any sicknesses or alterations in health detectable by modern methods of research, either during working life or later (TGL 32, 600/601).
6. K. Marx, Economic and political manuscripts from the year 1844; German in MEW Supplementary Volume I, p. 538.
7. MEW 23, 529.
8. Cf. MEW 25, 260.
9. MEW 19, 228.
10. Harry Maier, *Gibt es Grenzen des ëkonomischen Wachstums*, (=Are there limits to economic growth), Berlin 1977, p. 29.
11. *Deutsche Zeitschrift für Philosophie*, 1973, special issue, p. 37.
12. Breznev, in a report to the XXVth Party Congress, Berlin 1976.
13. Maier, *op.cit.* p. 69.
14. Dietrich Bonhoeffer, *Letters and Papers from Prison*, ed. Bethge, 3rd edition, 1967, p. 38f.
15. Cf. S. Kierkegaard: "And to be with the eternal's help utterly and completely contemporaneous with oneself today is to gain eternity. The believer turns his back on the eternal so to speak, precisely in order to have it by him in the one day that is today. The Christian believes, and thus he is quit of tomorrow." (*The Concept of Dread*, as quoted in J. Moltmann, *Theology of Hope*, p. 29.).
16. "Reinterpretations of Luther's Two Kingdoms Doctrine in the 19th Century" (in German only), *Texts on the History of Theology and the Church*, 21, ed. Ulrich Duchrow, Wolfgang Huber and Louis Reith, p. 38.
17. *op. cit.* pp. 41-43.
18. Cf. R. Bultmann: "From the Christian standpoint, there is no protest against secular knowledge, because the eschatological view of the world is not a way of explaining the world but can only be effective in the decision of the moment" (*Glaube und Verstehen* vol. II, 1958, p. 77.).
19. "There is free scope for natural science beyond what theology describes as the work of the Creator. And theology can and must move freely where science which really is science and not secretly a pagan gnosis or religion, has its appointed limit" (*Church Dogmatics*, III, 1. Preface.).
20. This is stressed by G. von Rad, who is himself the principal proponent of the theology of creation on the basis of salvation history. *Ev. Theologie* 1964, No. 2, p. 57.
21. *Evangelische Kommentar*, 1975, I, p. 43f.
22. A. M. Klaus Müller, "On the meaning of suffering" (in German only), in M. Krauss and J. Lundbeck (edd.), *Die vielen Namen Gottes*, Stuttgart 1974, p. 323.
23. G. W. F. Hegel, *Philosophy of Right*, Preface.
24. C. F. von Weizsäcker, *The History of Nature*, University of Chicago Press, 1949.
25. C. Westermann, "The Old Testament and Theology" (in German only), in *Theologie – Was ist das?* ed. G. Picht and E. Rudolph, Stuttgart-Berlin, 1977, p. 49.
26. Wolf Krötke, "The Christian's Faith in the Creator" (in German), *ZdZ* 1977, p. 437.
27. G. Altner, "Natural Science and Theology – conflict partners in face of death" (in German), in *op. cit. supra* n. 25. Picht and Rudolph, p. 449.
28. Westermann, *op. cit. ibid.*
29. See Ev. von Weizsäcker, *Offene Systeme I. Beiträge zur Zeitstruktur von Information, Entropie und Evolution* (= Researches and Reports of the Evangelical Research Association, vol. 30, Stuttgart 1974).
30. W. Kreck, *Die Zukunft des Gekommenen, Grundprobleme der Eschatologie*, Munich 1961, p. 82.
31. *op. cit. supra* n. 25, p. 478.
32. Cf. Gerhard Liedke, "From exploitation to cooperation. Theological and philosophical reflections on the problem of the protection of the environment" (in German), in *Studien zur Friedensforschung 8*, Stuttgart and Munich, 1972.
33. Hermann Dembowski, "Approach to and sketch of a theology of nature" (in German), in *Ev. Theologie* 1, 1977, p. 33ff.
34. Klaus Michael Meyer Abich, "The idea of a practical theology of nature" (in German), in *Ev. Theologie*, 1977, p. 3.
35. G. Howe, in Liedke, *op. cit. supra*, p. 73.

36. J. Moltmann, "Creation as an open system" (in German) in *Zukunft der Schöpfung,* Munich 1977.

37. On this concept of ambivalence, cf. Klaus Müller, *Die präparierte Zeit,* Stuttgart 1972.

38. Klaus Müller, *op. cit.* p. 152ff.

39. G. von Rad, *Wisdom in Israel,* S.C.M. Press Ltd. London 1972, p. 128.

40. Klaus Müller, *op. cit.* p. 153, 156.

41. "We talk nowadays about quality of life, though we do not know precisely what constitutes it, still less how it is to be achieved. We speak of quality because we have been led astray by quantity. Here too, therefore, it is not knowledge but doubt which is the starting point." (E. Eppler, quoted by Jindrich Filipec, *Die Lebensweise im gegenwärtigen ideologischen Kampf,* Berlin 1976, p. 111).

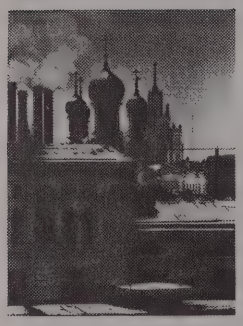
42. "By socialist life style we mean social conditions in which people can achieve the fullest possible satisfaction of their material and cultural needs and interests in keeping with the actual concrete stage of development of productive forces and conditions as well as with the development of the political and ideological superstructure of society". "We are dealing here with a qualitative phenomenon which is extremely complex, and difficult to quantify by ordinary methods of empirical sociology, for example." J. Filipec, *op. cit.* p. 87.

43. E. Jüngel, *Tod,* Stuttgart, Berlin, 1972, p. 80.

44. Martti Lindquist, *Economic Growth and the Quality of Life,* Helsinki 1975, p. 164ff.

45. Cf. the report of the consultation on the "Environment and the Future of Humanity" in Bückow (GDR), January 1978, A 12 f. (in German, roneod).

46. In an interim report on two years new life-style programme in Holland, H.M. de Lange writes concerning the action groups: "Their attitude tends somewhat towards intolerance, with one fatal result, especially in respect of the effectiveness of consciousnesss-raising: those who are opposed to any change in life-style and even people who are hesitant about it, see and feel themselves being driven into a corner, whereas people should be giving them signals of hope. The number of those who favour the maintenance of the *status quo* consequently increases, whereas little is achieved in the way of helping people to realize the necessity of a change in our living habits." (*Okumenische Rundschau,* 1978, 1. p. 49).



FAITH AND SCIENCE IN LIGHT OF THE SOCIAL-RELIGIOUS AND CULTURAL-SCIENTIFIC SITUATION IN POLAND

*by Msgr. Jozef Majka**

1. Positivistic-Scientistic Education as a Source of Disbelief

There is no need to recall that Poland has very close links with Western culture. The origins of this close association are usually looked for in the fact that we assimilated Christianity from the West, but here I do not want to simplify the problem as extensively as has been done by certain historians. Indeed, the cultural boundary between East and West already ran through and divided the multinational Polish state in medieval times, and even though the state as a whole formed part of Western or Latin culture and was very substantially influenced by that culture, it had to try to gain a certain understanding and comprehension of both the Orthodox and the Islamic East. But Polish literature, art and science always enjoyed rather strong links with the West.

This is particularly true as regards the fifteenth and sixteenth centuries, and later also as regards the nineteenth; and when I speak of the nineteenth century, I am thinking primarily of Enlightenment and Romanticism, two movements that made their influence felt in our society until as late as the beginning of the twentieth century. The rationalism of the Enlightenment subsequently took root together with the various forms of Positivism and Scientism.

In the period between the two wars a relatively strong Neopositivist school developed in Poland, and this was to some extent due to the influence of the so-called Viennese Circle. Two cultural centres (Lwow and Warsaw) and in each case two well known names (Twardowski and Ajdukiewicz; later on, Lukasiewicz and Kotarbinski) should be mentioned in this connection. Although Neopositivism, just like the later Structuralism, really aims at a self-annihilation of all philosophy, its markedly critical attitude was successful in sharpening and perfecting the tools available for thinking and research, so that in this way it made a very notable contribution to the development and critique of scientific methods of enquiry. It was rather well adapted to the scientistic way of thinking and for this reason was quite readily accepted by almost all educated people; seen from another point of view, however, it caused an immense desolation in the practical faith of these people, the so-called "Intelligentsia", so that throughout this period it was almost a fashion for an educated person to declare himself to be an atheist or, at least, an agnostic.

This disbelief very often proved to be somewhat inconsistent in actual practice, because the religious tradition had taken very deep roots in the everyday life of Poland. Even from a theoretical point of view, indeed, doubts regarding the faith were based more on a practical empiricism than on the critical analyses of the Neopositivists; but the critical attitude that the Neopositivist philosophers and their numerous disciples had aroused was always discernable in the background.

The Christian philosophers and theologians at that time were steering towards Neothomism, but within a short

---

* Monsignor Jozef Majka is President of the Pontifical Faculty of Theology, Wroclaw, Poland.

time they managed to learn a great deal from the Positivist logicians and methodologists, and quite a few of them, Salamucha and Bochenski being cases in point, allowed this learning to reflect in their findings; even at that time they already realized that the development of critical thinking and methodological rigour would not only further science, but could bring a certain benefit also to the faith.

2. Can There Ever Be a Real Conflict between Science and Faith?

In the postwar period it was not just the political and social situation in our country that became complicated, but rather the entire spiritual situation of society itself. The tragic experiences of the war were undoubtedly responsible for the fact that people began to place greater store upon the moral values of Christian charity, of mutual confidence, of culture, and also of religion. To all intents and purposes, indeed, the whole of society remained in a boundary situation and certain people, even though they have survived these boundary experiences, have not yet forgotten them. In such a situation it would have been nigh on ridiculous to question people about ideological differences or to preach to them new and unfamiliar nostrums; because in fact they trusted only what they could check by direct experience.

The Catholic Church, which in Poland has been closely united with the nation and its culture for many centuries, did not at that time question people as to their views and, both during the war and in the early years of the postwar period, tried rather to help people, to save human lives whenever possible, and to remain responsive to all. In the West there were quite a few people who bemoaned the fact that in Poland, as Karl Rahner put it, "there was no ready-made theology" to permit the Church to debate with Marxism; but those who complained in this way did not have a very clear idea of our situation and, above all, they did not realize that in this situation even the Marxists had toned down and practically stopped all theoretical attacks on religion and faith.

Even the so-called theoretical situation in our country underwent substantial changes after the war. Both Positivists and Christians had to accept a third partner, an official Marxist ideology, which before the war had been relatively little popularized. The first broadsides against Marxism were fired by the Positivist side immediately after the war (Lubnicki), attacking the Marxist theory of cognition. The Christian philosophers, too, at that time entered into polemics with the theses of materialism. Within a short time, however, further confrontation proved to be impossible and, for practical purposes, both the Positivists and the Catholics became divided into two groups:

a) One group of the Positivists withdrew from the debate and began to dedicate itself almost exclusively to the formal sciences (logic, methodology, theory of cognition); the second group (Schaff and his disciples) tried to expand the Marxist philosophy and to enrich it with the results of other philosophical trends (Neopositivism, Existentialism, analytical philosophy). This second group later caused a crisis in Marxist theory and gave rise to a new revisionist deviation in socialist thinking (Schaff, Kolakowski, and others).

b) Two groups can also be distinguished in the ranks of the Christian philosophers and theologians. One of these groups has basically remained anchored to Neothomism, although it tries to give an existential interpretation to Thomist thinking (Krapiec); some members of this group even wondered whether it might be possible to arrive at a rapprochement between Thomism and phenomenology (Wojtyka). Another group concentrated on logic, methodology and the so-called metasciences (Kalinowski, Kaminski), this rather under the influence of the Neopositivists and yet to some extent independently of their analyses. One could even speak of a certain armistice between Christian philosophy and other philosophical orientations. The causes of these attempts at rapprochement are rather complex and we can hardly try to discuss them in detail here. We shall therefore limit ourselves to the facts.

First of all, one may note a process of true rapprochement between the theologians and the phenomenologists in the sense that phenomenology was expected to provide some help for theological considerations and interpretations. Some authors even insisted on speaking of the end of Thomism, and thought to find in phenomenology a panacea for the entire misery and distress of theology, of ethics, and even of sociology (Tischner).

Indeed, at this time there is practically no confrontation, at least no open theoretical discussion, between Catholics and Marxists. Although both sides are quite busy talking about the possibility and the usefulness of a dialogue, in actual practice, however, it never took place. This does not mean that the two sides remained wholly passive. Quite the reverse. They watched each other with great interest; people tried to draw attention to the problems to be discussed, but neither an open public debate nor a press discussion of any length ever got under way. In the last resort, both sides limited themselves to an analysis of these problematics "inter nos", within their own circles, but only very rarely in encounters with the other side. What we have here is not really an armistice at all but rather a tactical avoidance of battle.

On the other hand, it does seem possible to speak of a true armistice between Catholics, on the one hand, and Positivists, scientists and all kinds of technical thinking, on the other. The causes of this mutual attitude call for a more detailed description; very briefly, however, one can interpret it as a recognition of each other's competence. But the problem is very complex in character, and is also conditioned by historical and sociological aspects. From a purely theoretical point of view, this attitude seems to be perfectly clear: A precise formulation of the problems and an indispensable methodological discipline oblige every scientist to remain faithful to all the conventions of his discipline, but also to accept its limits, and this means that he should not make any statements or claims that he cannot adequately define in the language of his discipline or prove with the help of its peculiar research methods or analyses. It needs to be emphasized here that the linguistic differences between various kinds of sciences, especially between the natural sciences, philosophy and theology, are of such importance that it is really impossible to find any gangways from one to another.

But we must remember that the meaning of the word "science" has been substantially limited here because, as we know, Positivists regard only the so-called "protocol statements" i.e. statements whose content rests exclusively on direct observations of physical or psychological facts, as at all meaningful and hold that the only theses to form part of science are those that can be scientifically (i.e. empirically) proved or turned into axioms. In the last resort, therefore, there can never be a confrontation between science and theology and, consequently, it is quite useless to speak of a theoretical conflict between science and faith.

But we must not ignore the fact that in the background of such an attitude of the natural scientists there are many evident traces of a boundless arrogance or, at least, a cognitive optimism. This optimism, which even the Marxists seem to preach, finds its justification in a simplified mathematico-materialist concept of the world. It is thought that there is practically no difficulty in understanding the whole of reality by means of scientific methods. On the other hand, many Christian philosophers hold that a natural scientist

neither can or should know or say anything about the nature or the causes of reality. For this reason they regard both the Marxist and the Teilhardian synthesis between science and philosophy as an inaccurate simplification and a methodological misunderstanding, and in some cases even as pure fiction.

In this way, relying on methodological rigour, the Christian philosphers wanted to believe that the centuries-old conflict between science and faith had at long last been settled. Laplace's famous statement that he had no need of the hypothesis of the existence of God has here received a new interpretation.

3. A Crisis of the Natural Sciences?

But this negative solution could not end the old dispute quite as easily as all that, nor could it be recognized as wholly satisfactory, especially in view of the fact that modern developments in the natural sciences have introduced many new elements into the conflict. Even today cognitive optimism has already been shaken. Nor do people speak with quite as much enthusiasm about the results of the natural sciences and modern technology; quite the contrary. Each passing day brings its revelation of some new proof of the limits of scientific methods. The development of the sciences has thus of its own accord, so to speak, uncovered not only its own possibilities but also its own limits.

This problem can be illustrated by a few examples:

a) Many so-called scientific axioms and theories have had to be recognized as inadequate, open to question, and even as false and naive; and things that seemed to contradict these axioms have been proved to be true and beyond doubt by science. For this reason a Polish scientist said in an interview: "As a scientist I have to assume as possible even things that seem to me to be improbable".

b) This modesty of the scientists also stems from the fact that with increasing clarity they are beginning to recognize many and even fairly wide domains of reality which seem to be inaccessible to known scientific methods and, what is more, cannot even be meaningfully described in the language of existing scientific disciplines, mathematics included. One may therefore ask whether there is not a need for a general critique of all scientific principles and theories.

c) Critical natural scientists feel obliged to draw attention to the so-called "singular or unusual" aspects in scientific research. Yet what are involved here are the most important nodal points of reality which seem resistant to research and analysis of any kind: for example, the zero dimension of the expanding universe, the beginning and nature of life, the problem of human consciousness, parapsychological phenomena, and so on.

d) Enthusiasm for science and technology is gradually turning into a certain disappointment because many of their results have in the end proved inimical to man and have become a serious threat to his existence. Even Marxists, whose entire ideology seems to be founded on belief in the ceaseless and ever-increasing development of science, technology and the economy, are acutely aware of the problem and, no matter how hard they try, cannot avoid the questions about the meaning and purpose of human life.

e) Over and above this, and this is my last example, we must not forget that scientists, as human beings, are not content to remain within the limits of the scientific world-view and show a great interest in human problems. This is not just a flight from their everyday scientific problems; rather they are looking for help in their scientific work; they want to find new elements for their scientific problems.

There are thus many signs that seem to bear witness not only to a negative compromise but also to trends in the direction of a positive rapprochement between the natural sciences and such disciplines as philosophy, theology and other human sciences.

4. Three Types of Scientific Cognition

Having already touched upon the human sciences, I cannot but recall that these sciences, too, are now in a state of tension with the faith, and this is the second focal point of the conflict between science and faith. This second conflict, indeed, could be more dangerous in future than the first.

With a view to throwing more light upon this problem, I shall try to distinguish three types of scientific cognition. These three forms of cognition should not be confused with either the three thought periods of A. Comte nor with the three "degrés du savoir" of J. Maritain. I am referring to three types of cognition that developed in successive historical periods and yet are all present in the world of today, although their mutual relationships are not always completely clear.

Let us note however that:

a) In Antiquity and in the Middle Ages cognition concentrated on ideas (not necessarily in the sense of Plato's world of ideas) and at that time one could speak of three sources of knowledge: books, masters, and thought. Endeavours were made to reach truth through the creativity of human reason and not by contemplating the world. Even Albert the Great, who is today esteemed not only as a philosopher but also as a scientist, could still mock an opponent for seeking wisdom not in books but in a smithy.

b) The development of scientism has turned the attention of scientists to the cosmos. One no longer seeks wisdom; the whole of scientific activity is subordinated to practical objectives; the natural sciences serve industry and, unfortunately, often also war, that is to say, the annihilation of man.

c) About two centuries ago science discovered man as man, i.e. as a microcosm, as the creator of history and the founder of cultures. But the whole difficulty lies in the fact that the problem of the cultural sciences, of their conception, their methods and even their purposes, is always left open. It is not possible to discuss here all the tendencies and movements, which in the human sciences never stopped changing during these two centuries (psychologism, naturalism, scientism, historicism, socilogism, various exegetical fashions and methods, etc.), or to report all the debates, which even today are still very lively. But it would be even more difficult, although in my view necessary, to look for the new solutions to these problems. Here we are interested only in a problem of the mutual relations between the human sciences and theology, or even their relation to religion in general.

5. Human Sciences and Religion

We shall limit ourselves to two brief remarks; the problem is too huge to be analysed in detail in these notes. I have already discussed it elsewhere.

a) In the first period of their development the cultural sciences remained under the influence of scientism, that is to say, they continued to seek simplification. Attempts were made to explain the whole culture and history of mankind by means of a single universal factor or to fetter them in a single common principle. One can therefore easily understand that at that time even religion with all its phenomena was conceived as a product of culture and an element of social life, and that attempts were made to determine the causes of the origin and the development of religious life in this way. Following this first "Storm and Stress" (*Sturm*

und Drang) period, however, the human sciences, at least in our country, seem to be acquiring a critical and methodological self-consciousness. Even the Marxists have in recent years become more prudent than before about giving simplifying interpretations.

b) On the other hand, it is perfectly clear that the development of the human sciences, their researches, and above all the new methods of interpretation that have come into being during the last few decades, have brought a great deal of help to theology and much further fruit can be expected from this collaboration in the future.

6. On the Way to Metatheology

Thus it only remains for us to consider briefly the problem of the scientific character of theology. In our country this matter has been debated frequently and somewhat heatedly during the last few decades. This was due to the fact that the methodologists attacked the scientific character of theology, doing this, to be precise, from the point of view of the possibility of verifying one's propositions, which they assumed to be an indispensable criterion of scientific cognition. The criterion itself cannot be called in question, but the problem arises as to how one can or should understand this verification, and also the problem of the verification method. It is well known that Marxists learn from practice, which for them constitutes a mode of verification, and that two verification methods are usually assumed i.e. empirical and logical verification. The theologians (Rozycki) are trying to introduce a new distinction here in an attempt to save the scientific character of theology. Indeed, they make a distinction between verification of the research results and verification of the research process, and claim that only this latter type of verification has to be possible before a discipline can be said to have scientific character.

The dispute about the scientific character of theology, as also about the theological methods, is still very far from being resolved, and it would hardly be appropriate here, on the fringe of the problem, as it were, to enter into some of the details of this dispute. I should only like to report that in our country people are beginning to talk about metatheology and that attempts are being made to do something in this field. The last theological congress in Cracow in 1977 made it clear that this problem is now attracting the interest of almost all theologians and methodologists.

The well known definition of theology as "a critical reflection about revelation" is undoubtedly inadequate, mainly because it can be interpreted in many different ways. In one of the principal lectures at the congress I have just mentioned the speaker (Kaminski) asked whether theology was to be a "rationalization of revelation" or a "revelationization of science". Both formulations are again open to many different interpretations. In the last resort, if we really want to speak of theology as a science, we must also keep our eyes on the problem of the distinction between theology and the religious sciences; and even further in the background there appears the question regarding the common formal object of all the theological disciplines, as also the one regarding their systematization.

I probably do not exaggerate if I assure you that the metatheological discussions have already produced a certain effect in our country. The attempts to systematize the theological disciplines, to define their common peculiarity and to describe the theological methods have made remarkable progress during the last few years, although not all of these attempts have yet been published.

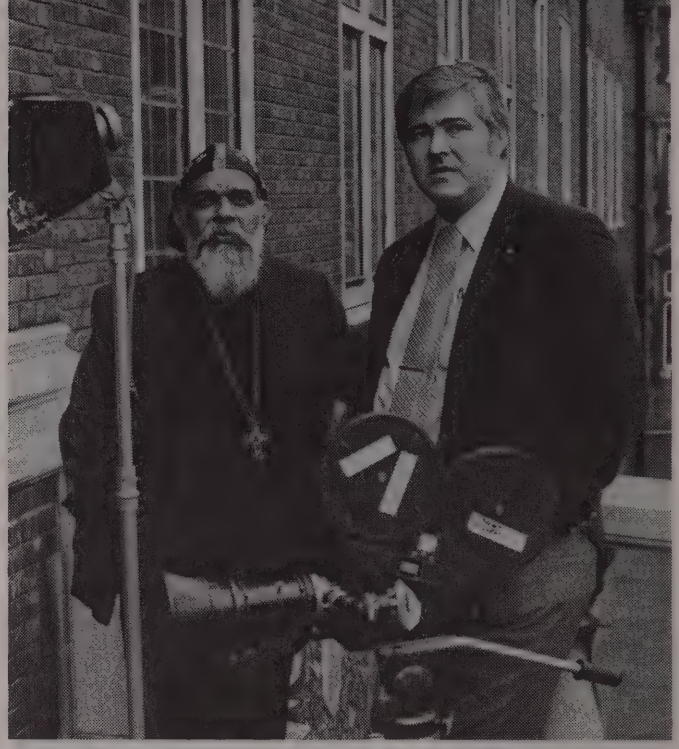
Will any of this bring us closer to a final solution of the problem of "faith and science"? This question must remain unanswered for the moment. But one thing is certain, namely, that in theology one must continuously seek a synthesis between all the results of human reason and divine revelation. If such a synthesis is to be attained, it is quite essential to stick to the old principle "distinguer pour unir" (distinguish in order to unite).

II

Media for the Meeting

These pictures were taken during the filming at Church House, headquarters of the Church of England, London, of one of three documentaries by the American CBS TV on the Conference – Science and Faith. The first film was shown on Sunday, May 13th over the CBS-TV network in the USA. Joe Clement the producer-director, will cover the meeting at MIT and produce a major documentary on the issues of Faith, Science and the Future for television release in the "States" and elsewhere. It will also be shared for "group media" use after the conference. IKON, the prize winning ecumenical television organisation in the Netherlands will also produce a major film report of the event, which will be available to member churches.

The Conference, and the ethical issues it will highlight, will thus be communicated by sound and image as well as through the press. We in ecumenical communications would like to appeal to all interested persons to share with us information on films and other expression that can be used in forms of "group media work".



Metropolitan Paulos Gregorios and CBS Producer Joe Clement.

Charles Birch, Professor of Biology, Sydney University being interviewed by Hal Walker (CBS).

CBS Interviewer Hal Walker talks with Dr. John Francis of Edinburgh, Scotland.

III

A New Economics for the JPSS?*

(Report of a Consultation on Political Economy, Ethics and Theology: Some Contemporary Challenges, Zürich, June 5-10, 1978)

I. Ecumenical Concerns in Relation to Current Economic Questions

It is time for the ecumenical movement to make afresh a critical review of economic questions. A number of problems have arisen in both the developed countries and the developing countries, and in their inter-relationships. Current political, economic and social thought provides no clear answers to many of these questions. Models and theories of the past do not fit all the facts. Problems of poverty and injustice persist. Even affluence has become problematic, coupled with inflation or unemployment on the one hand, and deterioration of human relations on the other. New insights about the finiteness of resources and the fragility of the environment have raised new issues. As a result, world economic thinking is now at a turning point.

It is in this context that a group of economists, social thinkers and theologians have met to consider the nature of economic paradigms, and their correlation or lack of correlation with current political economic reality, viewed in the perspective of Christian faith.

In this document a paradigm is understood to be a basic image, an intellectual model used to interpret reality and guide action. From it arises a cluster of interrelated propositions accepted as a conceptual framework for analyzing, understanding and predicting phenomena. Paradigms may co-exist in competition with each other, or in a complementary relationship. Paradigms are determined by some general consensus among practicioners of a discipline. Advocates of an ideology or world-view also develop a consensus around paradigms. Cultural factors are an inescapable component of such a consensus. Assumptions about interpersonal and social relations as well as about the relations of humanity to nature underlie such a consensus. There is a need to re-examine continually the meaning of paradigms and the social values they embody.

The ecumenical movement has historically been concerned with many aspects of political economic thought and structures. This concern has included a desire to understand more clearly political economic reality and thought as they exist, to search for ways to vitalize political economic analysis by reference to ethical norms inspired by a faithful interpretation of the Gospel, and, therefore to press for change that will bring justice in the world.**

However the present level and scope of the ecumenical concerns – expressed by a Just, Participatory and Sustainable Society – are greater than at any previous time. A series of pressures and influences have come together to create a growing unease about the nature and direction of political economic events and about the adequacy of current paradigms of political economic analysis for explaining or guiding them.

The struggle for economic improvement has for some time been a major preoccupation, accentuated by the failure of current economic growth and modernization paradigms to provide an adequate framework for effective human fulfilment in a wide variety of countries (not excluding socialist countries). The malaise over the direction of development policies has also been heightened by the growing awareness of communities and individuals that underdevelopment and development are interrelated – the two faces of the same coin.

Until recently the developed market economy countries were primarily preoccupied with the frictions and problems arising out of what were in general apparently successful economic growth policies. However, since the beginning of the 1970's four major factors have removed the sense of achievement and success, replacing it with doubts – and even alarm – about the possibility of achieving previously set objectives or of actually controlling and managing the political economic system. One is the cluster of issues encompassing ecology, resource limits and physical sustainability. The second is the set of economic factors signalling policy failure: low or no economic growth, very high and chronic unemployment levels, structural employment problems, recurring waves of inflation and precarious balance of payments situations. The third is the growing awareness of the effect of transnationalization of capital and processes of production, accelerating profound changes in the international division of labour. The fourth is a recognition of the importance of institutional and political factors as vital determinants of patterns and rates of economic development; there has been a tendency to keep these considerations out of the economic calculus by labelling them "non-economic".

In reaction to these four factors, many in the developed market economy countries, as well as elsewhere, now feel acutely the need for a reappraisal of the assumed goals, and the need for a more critical understanding of the nature of the consumer goods society to which so many millions of Christians find themselves committed. Such a reappraisal is seen both as a part of the task of assessing the extent to which such a society is justifiable and as essential to theoretical understanding of the system, if it is to change.

The doubts go deeper still. There is a growing awareness of the need not only to reconstruct political economic theory but to do so in the widest possible context of changing social and cultural structures, since the accepted system of political economic analysis is now being recognized for what it is: a derivative of the wider social cultural system. If this reasoning is valid, it can be extended with added force to the international context. The time is past when world political economic problems could be analyzed by applying a Western-based view to both the developed market economies and the developing countries. The increasing intellectual input from the developing world, the socialist

---

* JPSS is shorthand for the just, participatory and sustainable society, the newest definition of ecumenical social hope.

** "Political economic" is used here as the adjectival form of the nounphrase "political economy"; for this reason the two words are not linked by a hyphen or a conjunction.

world and a new critical awareness in the West itself is not only challenging the validity of applying Western-type models to these economies but also revealing the limitations of these theories in the West itself.

II. Some Values for Political Economic Thought

Any consideration of the values underlying economic thought has to begin with a statement of the goal and the norms of political economic activity. The goal could be defined as the enhancement of the quality of human life, both personal and social, in the process of human beings' creative interaction with each other and with their environment.

The following concerns are central in the evaluation of political economic activity, its norms and theoretical perception:

1. Persistent injustice: expressed in inequality in the distribution of power, wealth and knowledge; in the prevalence of structures of domination and dependence; in the growing concentration of power in governments, corporations, national and transnational bureaucracies and individuals; in the exclusion of the majority from the benefits of growth and in the exploitation of the many by the few. At this stage of human history striving for greater justice is the highest priority value in planning for the organization, institutions and processes through which political economic activity is carried out.

The striving for greater justice starts with the establishment of the norms for production, distribution and consumption which regulate the economic machinery. Justice cannot be introduced only after production is completed. This involves four major considerations:

(a) acknowledgement, and not suppression, of the power of individuals to participate in the decisions that affect them;

(b) elimination of inequalities in income and wealth, including the possibility of fixing permitted maximum as well as guaranteed minimum levels;

(c) acceptance of an increased measure of self-reliant action;

(d) reduction of damage to the biosphere from pollution, resource depletion, upsetting of ecological balance; and its maximum maintenance and improvement for the benefit of present and future generations.

2. The coexistence of affluence for one third of the human population side by side with misery for the majority raises questions that go beyond mere symmetry in justice. Three problems have to be considered:

(a) Increases in material consumption of affluent individuals and communities are counter-productive in terms of human well-being, yet societies are aggressively promoting the philosophy of growth in terms of targets; such aggregate performance criteria, at best, do not address and, at worst, compound inequality.

(b) The limits to known resources, the high and increasing level of scarce resource use and waste prevailing in affluent societies are leading to quite serious shortages and to an adverse environmental impact. The further question arises: As these materials are bid away from poor countries and contribute to a deteriorating environment, how can the minimum needs of the majority of the world's peoples be satisfied in this situation?

(c) How is the transcendent ideal of the Kingdom of God, which envisages a society where social concern would be the motivation of production, to be related to a productive system motivated mainly by restricted interests of individuals or collective élites?

3. These considerations lead to other relevant questions:

(a) What is the best institutional arrangement for the ownership of large-scale means of production? Private? State-owned corporations? People-owned and people-controlled enterprises?

(b) How shall the concentration of power demanded by high technology and complex organization be made accountable to the people and be regulated by them in the common interest? How might human knowledge (including science and technology) best be socially controlled and used in the service of humanity? Should the option of diminished use of high technology be considered, if this would make social control easier?

(c) How do we assure that economies generate full employment and keep the inflation rate manageable in view of the fact that unemployment and inflation increasingly seem to become endemic to the market economy system?

(d) How do we ensure that economic activity satisfies the needs of all rather than providing a choice of luxuries for the few?

(e) What means can be developed to ensure that the full social costs and benefits (including those not usefully reduced to some common denominator, such as monetary equivalent) of a particular mode of production are taken into account?

(f) How can the balance between the production of consumer commodities, on the one hand, and public or communal services like health care, education, transportation and recreation, on the other, be adjusted in the interest of human well-being?

The above questions may not have answers that would fit all situations. But in each situation they need to be asked by the people (not just by the "experts") and answered by them. All values reflected in these questions are grounded in a Christian concern for the well-being of humanity. The Christian assumption is that the human being, both individually and corporately, is capable of both good and evil, and that each generation, as stewards of creation, has a responsibility to God for contributing to the struggle for more justice in society; for naming and struggling against the principalities and powers which in varying institutional manifestations confront every human society.

III. An Enlarged Frame of Reference

Three concepts have emerged in the ecumenical debate as normative to a vision of the future society: justice, participation and sustainability. We begin with a consideration of these.

Justice

The nature of justice has been discussed for centuries. In the West, the Roman notion of *justitia* has usually been dominant – the ideal of "fairness", of everyone being given his/her due (*suum cuique*). This conception has been basically atomistic and distributive.

The Old Testament conception of "righteousness", for which the prophets battled, was applied more to Israel as a commonwealth than to individuals. In the name of "righteousness" they challenged the injustices of a society in which the poor went hungry and were exploited by the rich. This social understanding of righteousness as related to structures of political economic organization needs special attention at this time.

In the New Testament (see e.g. Luke 1:51-53; 4:18; 5:20-21; 5:24-25; 18:24; James 2:1-7; 4:13-5:6), justice means the vindication of the poor and the oppressed. Thus

the Gospel leads Christians to a commitment to an equitable society in which every human being has significance and dignity and where none is oppressed. This vision should not be reduced to mere equality of opportunity for all individuals to compete without hindrance. Such equality has only helped the clever and the mighty to get even further ahead and to create a power élite which oppresses and exploits others.

Justice is inseparable from the Christian concept of love or *agape,* which means, among other things, creative sympathy for the suffering and the oppressed, siding with them and furthering the interests of others even at the expense of one's own. The Latin equivalent of *agape, caritas,* is the source of the English word "charity", whose meaning has often been perverted in the churches. It has frequently been misinterpreted to mean optional, individual charity to those in need, without any reference to efforts to correct the structures which created that need. In our time, the concept has taken political economic shape as optional, voluntary aid from nation to nation. This can be no substitute for dealing with the international structures which give rise to the need. The demand for justice applies to structures of relationships between nations, within nations, between regions and groups in a nation, and so on.

At every stage in history economic and political institutions and structures have been the instruments that have mediated the level of justice in a society. They are therefore the focus in the identification of the key areas in the struggle for justice. Hence the importance for Christians of seeing that it is in history that the word of God, both to individuals and structures, is encountered and the tension between human obedience to the Gospel and human sin is experienced.

Participation

The pursuit of justice goes beyond distribution and involves participation in deciding what is produced and how it is produced. As people become involved in making decisions in a society, they see the need for structural change at every level especially when questions of development are involved.

Both the existing free market and the centrally planned economies make some provision for participation. However, the principle of consumer sovereignty – the predominant form of participation in capitalist societies – is neither adequate nor truly operational in systems which are characterized by concentrated economic power. Nor do central decision-takers always either know or act upon the people's perception of their needs.

Production based on modern high technology is extremely complex and often demands large-scale organization. The interest of greater efficiency and that of larger participation seem thus to come into conflict. The search for appropriate technology is an attempt to combine technological efficiency with adequate social control in such a way that the obstacles and difficulties to be manageable and comprehensible at the local communal level can be surmounted. Even where large-scale units are essential, means must be found to involve the people in the decision-making processes related to production. Complex industrial organization requires new and more complex patterns of participatory social organization. The power of capital and technology must be counter-balanced by the power of social and political institutions to control and regulate them. This does not imply that individuals and groups will always reach a common mind. Nor does it mean that the decisions made will necessarily be wise, or that they will always be taken in time, if participation proves a lengthy process. These are inherent hazards.

While there is growing demand for decentralization and participation, the trend in industrial societies is towards greater concentration of control. The growing sense of powerlessness on the part of people to control the political economic process or to change structures is not mitigated by the power of the vote alone, although this is the major component of political processes in many societies. If participation is not to be eroded by the dynamic of technology and industrial production, new structures beyond the present electoral systems must be found.

Sustainability

Sustainability includes issues like the right use of finite resources, the right understanding of the interrelation of humankind with nature (the environment, the biosphere) and the use of technology for the conquest of nature, and the way in which the technical domination and maintenance of nature have contributed to the liberation of people, but also to their domination.

While justice points to the necessity of building societies that will endure, of correcting maldistribution and overcoming the gap between rich and poor within and between countries, sustainability points to humanity's dependence upon the earth, and the way in which world society organizes itself for developing natural resources. However, there is a close relation between the two. "A sustainable society which is unjust can hardly be worth sustaining. A just society that is technologically and ecologically unsustainable is self-defeating."

A sustainable society is conceived as one in which the number of people, the rate of use of resources, and the rate of pollution of the biosphere are within the capacity of the earth to support and in which an acceptable quality of life could be sustained indefinitely for all people. As the report of Section VI of the Nairobi Assembly stated: "This will involve a radical transformation of civilization, new technology, new uses of technology and new global, economic and political systems."

At first glance, unsustainability may seem to arise primarily from increasing consumerism and the rate of economic growth alone. But closer examination reveals as well the confluence of forces which drive the system towards an ever-increasing accumulation of capital in private and state hands without social control. Competitive industrialization, without societal goals defined by the community, leads to the increasing misuse of science and technology, a fostering of a constantly enlarging demand for consumer "goods", supported by a never-ending stream of new products answering a mix of real and artificial needs. All this leads to a narrow kind of economism with the result that people are tempted to limit their horizon to mere economic objectives, contributing, therefore, to their own increasing alienation. When the competition accumulation and the quest for profit orient the administration of science and technology the result is the exploitation of natural resources (the material environment) within the short-time horizon of return on capital, be it private or public, rather than within the long-time horizon appropriate to the interests of humanity and the whole of society.

Equally important is the fact that a world as heavily armed as it is today is a permanent threat to sustainability. Economic considerations must take into account both the frightening destructive potential of armaments and the colossal waste of resources and human effort that they now entail. It should also reckon with the linkage between the manufacture and trade in armaments and the industrial system. These issues are discussed in the Report of the WCC Conference on Disarmament (Glion, April 9-15, 1978).

IV. Towards Justice through Physical Sustainability and Limited Inequality

Justice has to do with the production and distribution of the fruits of human efforts and nature's bounty, not only by and among people now existing but also between present and future generations. Justice over time requires sustainability. This dimension has been neglected, because the heavy reliance of the present technological and economic systems on non-renewable resources has only recently been recognized and the time when they will be exhausted cannot be known precisely. Moreover, the scale and rate of growth of these economies have led also to the exploitation of renewable resources beyond their capacity. Grasslands are overgrazed and converted into deserts, a process which antedates the industrial era. Croplands are mined of their nutrients or paved over for non-agricultural use; fallow cycles are shortened in order to increase current production; the forest area is reduced by the pressures for firewood, lumber and paper; and the fisheries of the ocean are being depleted by over-fishing and pollution to the extent that the world catch has decreased in recent years in spite of augmented fishing efforts. Even more serious than the limited capacity of grasslands, croplands, forests and fisheries to supply inputs for future growth is the overuse of the capacity of eco-systems to absorb inevitable waste, leading to a reduction of their ability to supply clean air and water.

There is a major debate on the degree to which technology, costs and prices, and management can, and are likely to, reverse, halt, delay or, for that matter, accentuate this deterioration of both the renewable and non-renewable resource base. Moreover, even though some of these threats may be pushed to a point so far in the future that they are of little help to the present generation in shaping its perspective, other limits may be far more stubborn and close at hand and ground for imminent concern.

The present pressure on the biosphere in general and on resources in particular comes primarily, though not exclusively, from a minority of humankind that seeks to sustain a morally injustifiable scale of consumption for itself. Consideration of population pressures in all societies should not be dissociated from the enormous differences in levels of national consumption. Both are relevant to any scheme for preventing the erosion of the earth's finite capacity to support human life in the future.

Justice demands an equitable system of production and distribution among all in the present generation, as well as between generations. A permitted maximum and a guaranteed minimum level of income and consumption would be a step forward in the struggle for greater equality. Thus far the levels which exist have been considered only within each society; but today equalization between different societies has become one of the critical issues. It would call for drastic changes in values and attitudes as well as in national and international structures. The churches are becoming aware of the lessons learned by Christians living within the various socialist patterns of political economic organization and their efforts to solve the problems of justice, participation and sustainability.

V. Towards a New Paradigm in Political Economy

A Critique of the Current Paradigm

The paradigm of political economy currently prevailing in Western industrialized societies, and influential in many others, can be criticized in three broad respects: it gives insufficient weight to the historical (and spatial) dimension, it relies on a reductionist approach, and it defines its area of concern too narrowly. More specifically:

1. The prevailing paradigm makes particular assumptions about the humanity-nature relationship, which is conceived uni-directionally as one of domination and utilization. The new paradigm will have to be based on a more reciprocal understanding of that relationship, with more respect and care for nature.
2. The prevailing paradigm, for historical reasons, has in practice served primarily the interests of a minority of the world's people. A new paradigm should be consciously weighted in favour of the majority who are now victims of the system.
3. The system sees accumulation and growth as the primary means of staving off unemployment.
4. Resource exchanges are assumed to be most efficiently carried out through market mechanisms. As a consequence, the attempt is made to solve as many problems as possible within the framework of this institution.
5. It is assumed that economic agents behave rationally and pursue their individual or institutional self-interest exclusively, and that this activity results in the achievement of the greatest good for the greatest number.
6. It is assumed that consumer demand depends on consumer sovereignty, and is motivated by the satisfaction of independently determined individual wants.
7. Resort to equilibrium analysis minimizes attention to critical real world adjustment problems in the short- or long-run analysis.
8. The system incorporates no moral judgement about what is produced or who consumes how much. Income distribution is regarded as incidental to the organization of production.
9. Through its self-imposed limitations, the paradigm gives insufficient attention to the effects on economic activity of key social and political ingredients such as the role of institutions, concentration of power and the existence of class structures.

Outline of a New Paradigm

Clearly, there is need for a new paradigm that would correspond to the operational requirements of a just, participatory and sustainable society and inspire new understanding of the dimensions of poverty in the world and the demands of the Gospel.

Proposition 1. Reinstating the historical and spatial dimension

(a) Economic analysis must have a long-term perspective bringing in those variables hitherto kept constant, i.e. population, resources, etc.

(b) The time dimension must be introduced not as a hypothetical category (i.e. t_1, t_2... t_n) but as a historical reality. Political economy must address itself to what is likely to happen next in time set in the context of what has happened. The interaction between past and future is basic, but does not take the form of simple repetition or linear projection.

(c) The importance of this view to developing countries is that while their history is inevitably tied up with the history of developed countries (which is why they must always claim the right to seek to influence the course of developed countries), their experiences are bound to be different. Rather than looking for general laws germane to all societies and for a generally valid historical sequence, it must be accepted that the next stage of development for each country is likely to contain a uniqueness due to different modes and times of integration into the international economic system.

Proposition 2. Towards an integrative view

(a) The "reductionist" approach prevailing in economics is bound to fail when an attempt is made to solve the most pressing problems of our present world; the reason is that there are manifold interdependences in social systems which – when not taken into account – may (and often will) produce counter-productive outcomes. An integrated thinking is required which makes use of systems methods as well as other approaches that take account of cumulative and reciprocal relationships.

(b) Since the problems reach into various areas, various social systems, as well as the interactions among them, must be theoretically and empirically assessed. The research required is by its nature interdisciplinary. As an instance of specific relevance: increased welfare (improved health, nutrition, etc.) will have a positive effect on the labour productivity. Income redistribution (in favour of those who had not attained even minimum standards) will therefore increase the productivity, hence output. This is a blow against the classical – neo-classical doctrine which holds that consumption must be curtailed in order to increase investment, and as a result production, and consequently postulates unequal income distribution as a *conditio sine qua non.* This simplified assumption is not justified in a historical situation where labour is the major factor of production.

(c) A holistic view should shift its focus from self-interest to common social concern for the well-being of all, as the basic motivation for economic activity. This is not a question of distributive justice alone, but has to do with the values generated or reinforced in the process of production itself. An integrative view which takes into account more variables and at the same time seeks to continue the present pattern of economic organization with dominance by the few has no ethical justification.

Proposition 3. Economics must again become political economy

(a) An integrated view implies an analysis of the interactions of the social, economic and political systems. Clearly, this includes the analysis of the power relations, power structures, and institutions constituting or supporting those systems. Within the integrated view, there must be room for several "sub-models" for specific historical contexts.

(b) A clear and explicit normative statement is required. The confusion of positive analytical and normative issues, including the assertion that much can be said in political economy without value judgements (clean technical "solutions" based e.g. on the maximization principle), must be abandoned. The belief in a neutral science is closely related to the narrow analytical confines of the traditional approach.

(c) An empirically based welfare theory is needed that includes a far larger set of variables than was thus far believed to be relevant in determining human welfare.

(d) In welfare theory the discussion of the possibility (normative desirability, political feasibility, etc.) of providing a subsistence minimum and basic needs for all (including a far broader range than personal consumption needs alone) will constitute a major theoretical issue.

(e) The discussion on limits to inequality in terms of maximum and minimum levels will also be central.

(f) In reconstructing political economy, a more correct understanding of the complex nature of human behaviour, human well-being, and human needs will have to be articulated and reflected in the model. This requires the cooperation of various disciplines.

The Challenge to Economic Thought Today

The argument thus far may be summed up as follows: the economic assumptions which have developed in association with existing systems and power structures and which are used in defense of them can be refuted, empirically and ethically, and must be challenged. These assumptions include:

- economic growth must be a prelude to social justice and not vice versa;
- inequality is needed to produce savings and capital formation;
- economic growth itself promotes equitable redistribution;
- rationalization means mechanization;
- stabilization and the absence of inflation are to be preferred to the inevitable uncertainties associated with dynamic change;
- economic development in the developing countries should be modelled on that of the industrialized countries;
- the chances of development of underdeveloped countries are dependent upon, or even optimally secured by, a continued rapid economic growth in the rich Western countries.

Various alternative assumptions have begun to emerge which also need to be examined in open discussion:

- modernization (in the form of rationalization, maximization and centralization of technical and economic power) leads to increasing domination and not automatically to justice and participation;
- in the present system economic growth generally leads to injustice;
- at present technological advance tends to enhance the power of the powerful.

In this regard, the role of science and technology in economic progress needs careful re-examination. They are still the main resource for dealing with economic development problems. At the same time technical knowledge and skill are key sources of capital, profit and power. This new power is often appropriated by those in dominant political and economic positions. Science and technology do not exist in a vacuum but in a political and socio-economic context. Nor are they value-free. They affect the form of material realities and social perceptions. Moreover the cumulative impact of science and technology sets in motion social processes which are difficult to alter or reverse. Hence in the construction of new political economic models, provision has to be made for the social control of science and technology in the interests of justice, participation and sustainability.

VI. Further Exploration

The age of innocence is over. It is time to review and clarify the direction in which society should go *before* undertaking economic and social policies in the name of development and under the assumption that the society which is desired will be their necessary and automatic consequence. A changed system of values is a precondition for a change in economic systems. In this process of redefining the goals of society and shifting the gears of the economic machinery to attain them, a number of political, economic and cultural aspects deserve special attention.

1. A priority task is to take an institutional approach to justice and participation by devising social organizations which will work towards the implementation of the agreed goals rather than against them, or by modifying the existing institutions accordingly.

Such efforts should have the support of the churches which have too often accepted dominant power structures uncritically. For this exercise the churches in each country, if they will listen to fellow churches in other countries, have an unrivalled source of information on how such institutions look from a context different from their own.

2. It is urgent to investigate how organized pressure can be brought to bear on the powerful (nationally and internationally) to modify their policies in favour of a more just situation, i.e. one in which there is less dominance/dependence. The task is to reach agreement on those common values which would be supported by an interrelated number of common interests. How far are appeals to an informed conscience the answer? To a larger self-interest? To fear (e.g. the danger of local conflicts caused by economic misery spreading and becoming international)? By threats?

3. The role of ideology must be identified. Some form of ideology is always necessary to provide a conceptual framework for orienting national and international development. It is a prerequisite to the unity of a people and a country in striving for a common goal. As such it is an indispensable resource for national development. But it can also lead to a polarization of society which hampers the attainment, and even the formulation, of common goals.

As new models are developed on the basis of ideology they must not be regarded as absolute but rather as relative and provisional. Only then is open debate possible, and possible even where fundamental divergences exist. These differences themselves are often less clear-cut than they are in theory proclaimed to be. They are constantly being relativized by new facts, which call for repeated redefinition of points of difference and of contact.

It is possible for people and groups with differing ideological positions to agree on short-term goals without compromising their convictions. The argument here is against the rigid and dogmatic character of any ideology which refuses to be self-critical and is unwilling to benefit from new insights.

Détente, or relaxing the tensions of political and military confrontation between ideological or power blocs which expose the world to the threat of a new war, seems essential for world development with justice and sustainability. Political *détente* does not appear to lead automatically to the military *détente* and disarmament which could bring new hope to the world. *Détente* does not necessarily mean the playing down of genuine disagreements.

4. The meaning of self-reliance must be spelled out in its conceptual and economic dimensions.

Self-reliance begins with a process of psychological and intellectual liberation. Often it happens in the context of struggle. Only when it is achieved can the economic and political reality be freshly evaluated and the moves from imitation to authenticity be started. Decolonization starts in the minds of people.

The economic implications of self-reliance must be assessed in the light of this intellectual liberation. In such a perspective economic achievements which had seemed essential may become peripheral or negligible, and peripheral values may become major social and economic goals.

5. In this process of re-evaluation, the meeting of basic needs will assume first priority.

The term "basic needs" has a wide meaning. It includes material needs such as food, clothing, housing, durable goods, education, health care, transport and other services. It also includes social and cultural needs such as personal freedom, social security, access to information, justice in income distribution and in the conditions of work, access to culture and the right to leisure. Basic political needs cover participation in all levels of decision-making, limits to private ownership, national independence and the establishment of mechanisms for resolving international conflicts. The urgency of particular needs will vary in different countries and under different circumstances.

6. It is necessary to clarify the relationship between a strategy for meeting human needs and the strategy of "de-linking" (of choosing economic self-reliance and independence as opposed to interdependence which often leads to dependence). With regard to this concept of "de-linking", the following questions must be considered:

(a) How far is this a reasonable option for all developing countries and how far is it practicable only for relatively large ones which can satisfy the basic needs of their population without recourse to importation of essential products from the rich countries?

(b) How are ocean currents, the seabeds, and the use of space to be dealt with?

(c) What does a policy of self-reliance and de-linking imply for the developed countries which at the moment depend on essential raw materials from the Third World?

(d) What would be the implications for First World policy of the change of values which is the basis for self-reliance and consequent de-linking in the Third World?

7. In other words there is need for study of the meaning, feasibility and implications of the collective self-reliance of the Third World. In their relations with the developed world, Third World countries have to choose between the alternatives of negotiation and confrontation. Their choices will depend on the real possibilities in each situation. Experience has shown that their negotiating power depends on the possibility of efficient unilateral action. In this respect the united action of Third World countries, through the non-aligned countries, the group of "77" and the producer associations has proved of great importance.

VII. Recommendations

The World Council of Churches has, over the years, introduced a number of terms into the development debate within the Christian community to emphasize the point that development is more than economic and technological progress. The stress on social justice, self-reliance, people's participation and sustainability has contributed substantially to new and creative action by the churches. However it is not enough to define such terms, stress their importance and point out situations in which they were or were not implemented. What is needed now is an integrated approach which explores:

- how far these concepts are elements in prevailing economic theories or conceptual models;
- how far they are complementary or contradictory to these theories;
- how far they support each other in a viable and socially acceptable development strategy and how far they are mutually exclusive.

The aim of this work could be to show that these concepts are not to be inserted on an ad hoc basis into existing economic theories and development strategies but are the foundation on which a more meaningful development theory can be built.

The churches are especially well placed to call attention to the accounts and stories of all those whose concerns must be incorporated into the new conceptual models.

In respect to both this integrated exploration and the following specific proposals there is a strong case for seeking to encourage and to assist national and regional studies and consultations. Emphases on the importance of contexts,

of listening to voices from different experiences, on breadth and diversity of participation, all call for such national and regional work.

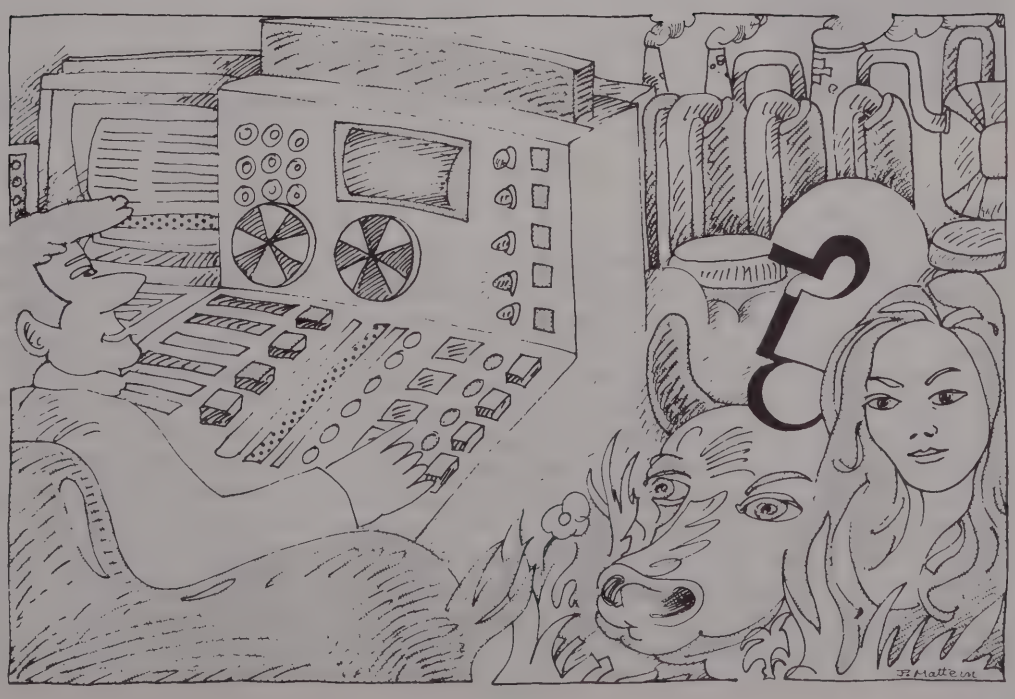
Three specific recommendations for attention by appropriate WCC agencies arise from the Consultation:

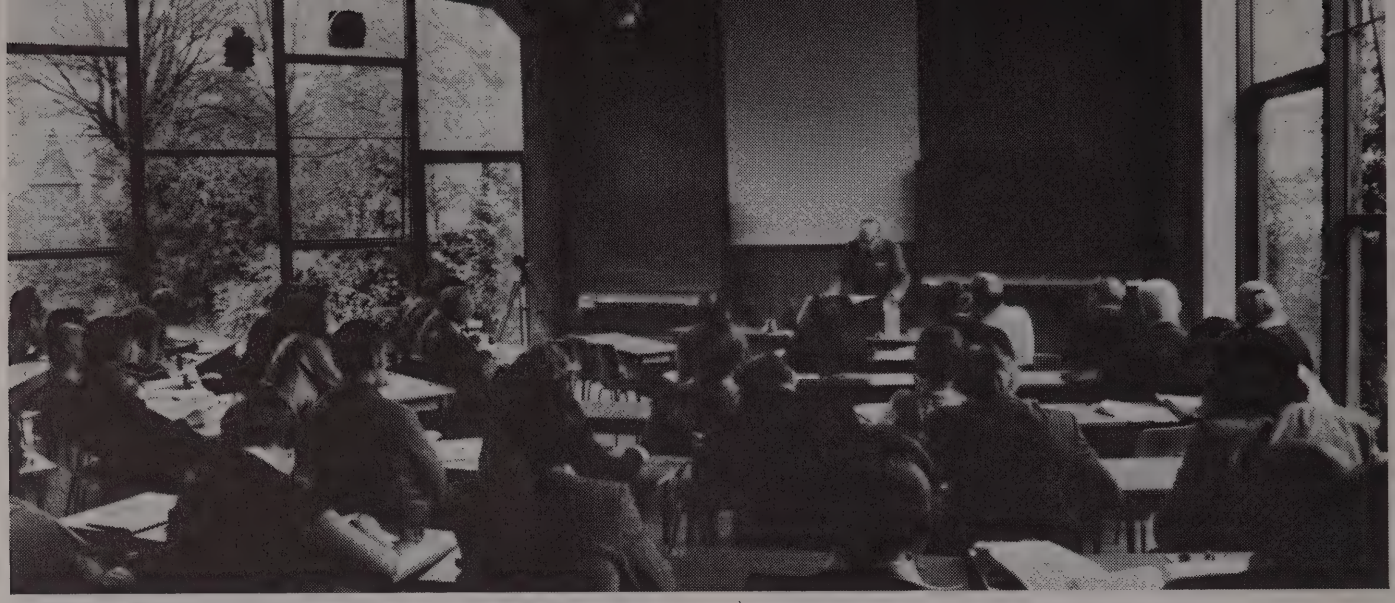
1. That the CCPD give high priority to a study of the concepts of collective self-reliance and the economic de-linking of developing and developed countries with consideration of the following:
   (a) the costs and benefits of economic self-reliance and de-linking;
   (b) their feasibility;
   (c) the strategy to be pursued to achieve them;
   (d) possible consequences for nations, regions and the world;
   (e) the extent to which development can be promoted with reduced interdependence;
   (f) the role of the TNC's in relation to self-reliance and de-linking.
2. That the CCPD explore further the relationship between its study of The Church and the Poor and the implications of that study for economic theory and systems.
3. That the sub-unit on Church and Society, in view of the 1979 World Conference on Faith, Science and the Future, give particular attention to the social and ethical consequences of present patterns of industrial and technological development, and evaluate alternatives which would increase world justice, participation and sustainability, with specific attention to:
   (a) changes needed in the traditional technological-industrial growth patterns in the industrialized countries;
   (b) the debate about appropriate technology and how this applies to the industrialized and the non-industrialized countries, especially in view of the problems of unequal political and military power which this might present;
   (c) an assessment of the consequences of further world economic growth (e.g. as envisaged by the *UN Report on the Future of the World Economy*) on natural resources and on the physical and human environment.

Facing the ethical issues

The engineering of embryos and brains. The interventions in genetic structures. The risks and repercussions of nuclear energy development. The social consequences of the computer revolution. We've hardly begun to form the moral framework for deciding about such issues: for what use, at what cost, for how many?

The choices posed by science and technology demand that we balance the risks, provide social justification and choose a time scale (the nuclear issue, for instance, depends very much on whether you're planning five or fifty years ahead).





IV

The Energy Debate – Continued

(Report from the WCC Consultation on "Ecumenical Concerns in Relation to Nuclear Energy", Ecumenical Institute, Céligny, Switzerland, May 2-7, 1978, and Related Papers)

THE REPORT OF THE CONSULTATION

INTRODUCTION

The World Council of Churches has, since 1974, tried to contribute to the growing discussion of the ethical and social problems associated with the increasing use of nuclear energy. The following report is the latest addition to this ecumenical discussion. It is the result of a five-day Consultation (May 2-7, 1978) at the Ecumenical Institute, Céligny, Switzerland, on the theme "Ecumenical Concerns in Relation to Nuclear Energy". The Consultation was organized by the sub-unit on Church and Society and attended by about 60 nuclear scientists, church leaders and theologians, representing a wide variety of opinion, including those strongly opposed and those substantially in favour of nuclear energy.

The purpose of the Consultation was defined by the Central Committee of the World Council of Churches at its meeting in Geneva, August 1977, in the following terms:

> *"In view of the fact that, in the course of the past year, the development and location of nuclear reactors has become an increasingly contested issue in several nations, and has shown the urgent need for church leaders and individual Christians to have more information and clearer awareness of the issues involved, the Committee* ***recommends*** *that the subunit on Church and Society organize a Consultation on Ecumenical Concerns in Relation to Nuclear Energy."*

The Central Committee specified that the Consultation should

a) have a balanced representation – pro-, anti- and undecided positions on the nuclear issue;

b) focus on the use of nuclear power for peaceful purposes in the context of world energy needs and possible resources;

c) examine the basis for assurances to the public on the security of the (breeder) reactor technology;

d) analyze the grounds on which local communities have objected to nuclear reactors;

e) aim at the further development of an ecumenical position.

The Central Committee concluded by noting that:

"The violence that sometimes attends demonstrations against nuclear energy or nuclear reactors (as in Malville, France, during this Central Committee) points to the degree of emotion associated with the immense interest in the issue, and urges the sub-unit (on Church and Society) to do everything possible to promote a sane and informed discussion of the issues involved. It affirms that decision-makers in all countries cannot avoid open public debates on such issues nor should they allow themselves to be guided by strictly economic interests on these matters."

19 participants more or less opposed to nuclear energy, and 17 participants who were, in varying degrees, in favour of it. The remainder were "undecided" or uncertain.

Following the discussions in plenary the Consultation divided into five Working Groups on

1. The Prospects of Non-Nuclear Energy Sources
2. Social Costs and Risks of Nuclear Energy
3. The Debate about the Breeder Reactor
4. Nuclear Power and Non-Proliferation
5. Ethical Issues in Relation to Nuclear Energy

The Consultation's report consists essentially of the findings of these Working Groups. Their reports were first discussed in plenary session; following the meeting these were integrated by the staff into a single draft report and circulated to all participants for comment or correction. The final text was prepared by the staff in the light of the comments and suggestions received.

The Consultation had access to a number of recent reports and statements on nuclear energy by national church bodies or national ecumenical councils, including statements from France, the U.K., the Federal Republic of Germany, Holland, Sweden and the USA. However, it must be recognized that these statements reflect to a great extent the uncertainty characteristic of the world-wide discussion of nuclear energy today.

The differences of outlook at the Consultation were very considerable; the debate was often tense and the disagreements profound. There were charges and countercharges of unfairness, and accusations and counter-accusations of a lack of Christian charity towards opponents. Despite these difficulties the Consultation held together.

No attempt was made to reach a consensus or to compromise in any way the views of any participant. It is recognized that the nuclear debate in a number of places has provoked a disturbing counter-reaction and a tendency to violent repression wherever there has been open confrontation between protest groups and the civil authorities responsible for nuclear power generation. This must be openly deplored but at the same time such isolated actions cannot be allowed to influence the balance of the international debate over the future of nuclear power development. However it is proper that there should be an open declaration of public fears and uncertainties whenever the issue is publicly debated and the present report from the Bossey Consultation is a further attempt to consolidate the position of the World Council of Churches as a contributor to this ongoing discussion.

I. THE PROSPECTS OF NON-NUCLEAR ENERGY SOURCES

1. Introduction

Over the past century the use of energy has increased exponentially. This trend is not confined to the industrialized countries. In the past few decades the increase – expressed as a percentage of the previous year's consumption – has been greater in the developing countries. Their energy consumption is however still at a very low level. World energy consumption as a whole has followed, essentially, the trend of the industrialized countries.

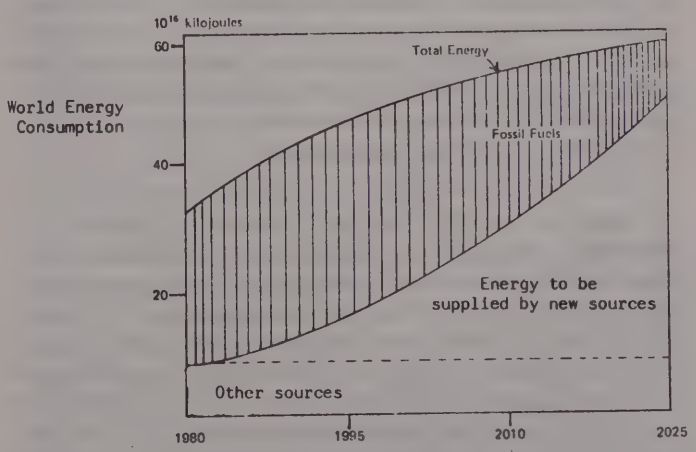
It is plain that this trend of growth (let alone growth at an increasing rate) cannot continue indefinitely, especially if it depends on fossil fuels. This is true no matter what fuel is utilized since resources other than fuel will limit growth wich makes use even of the "inexhaustibles". There are limits to the amount of energy which can be used.

Nevertheless, justice and humanity require that much more energy be made available to the populations of the developing countries. It is also expected that, over the next decade or two, there will be further growth in energy consumption in the industrialized countries. This latter point was discussed at length. In spite of all our many concerns for equity and justice, it was felt that some growth in the near term is inevitable. Only very stringent conservation measures in the industrialized countries, which we fully support, are likely to reduce the rate of growth in the near term, and it is unlikely that this will be forthcoming.

The greatest efforts have to be made to use energy more efficiently, to get the greatest value out of each unit of energy consumed. Energy must be seen as a uniquely valuable commodity to be used frugally, in that, unlike other raw materials, it is irreplaceable and cannot be recycled.

Energy consumption cannot be divorced from population growth. The trend of population growth appears to be irrevocably set for the next twenty-five years and this apparently increases the need for energy, whatever conservation measures can be adopted. It can be argued that an objective of zero growth in world energy consumption is unrealistic unless there is a corresponding stabilization in population. However it does not follow that an increase in population size must necessarily lead to an overall increase in energy demand.

These increasing needs have to be compared with the availability of world energy resources. On a world-wide scale, perhaps two-thirds of our energy comes from oil and natural gas, liquid fuels which will become depleted over the next fifty years. The situation we face is this:



Possible Pattern of World Energy Production 1980-2025*

*Energy sources supplying less than 1 percent of total are omitted.

The existing sources include hydroelectricity, coal and wood, which, as now used, can be expected to be still available for some time into the future.

This graph has been drawn showing that exponential growth can be controlled and that, at some time in the next fifty years, we should be approaching zero energy growth, on a world-wide scale, thus indicating an objective or a hope that with stabilized population growth, world-wide average per capita consumption might decrease. This could only happen if the benefits of natural resources were shared much more equitably between the industrialized and the developing nations. Possibly, or probably, the opposite will happen – i.e. under-sharing = greater per capita consumption.

This graph is an expression of the conventional wisdom which assumes that industrial growth and a consumer oriented society are appropriate objectives for humanity. It does not reflect the necessity of searching for other societies, structured on an entirely different economic and social basis, which could require much less consumption of the world's resources, but would, at the same time, give an equal or more satisfying life style for humanity. While a discussion of such possibilities is beyond the scope of this report, this is a very proper topic for discussion by the WCC and is, indeed, one of the ideas which is implicit in many of the discussions on the need for nuclear power.

We were asked to comment on the potential of various energy sources to supply these energy needs. It is important to note that, even if world energy needs did not increase at all (or even if they were to decrease significantly), there would still be, over the next fifty years, a need for the development and deployment of new energy sources on a very large scale.

Over the next twenty-five years changes will be largely restricted to increases in supply from conventional fuel, using more efficient technologies. There are serious practical limits to rate of change. It may take up to ten years to open a new coal mine for example, and the lead time for site approval and construction of most new nuclear energy supply facilities is comparable. As discussed below, the practical situation with small decentralized systems provides other limitations. In many areas the rate of introduction of solar heated houses is limited to the rate of building new houses. It is essential that high priority be given to the removal of institutional or other barriers which might limit the adoption of such technologies.

Because of the slow rate of practical change, high priority must be given to the early study and development of more benign technologies that are compatible with long-term patterns of resource use and availability. Unless they are developed now they will not be available for deployment twenty to twenty-five years hence.

A further goal which must be recognized is the development of sustainable energy sources which could supply energy for the world's needs for a very long time. This goal will only be realized if we prepare, in the most generous sense, plans for the long-term future and organize our affairs to avoid foreclosing any major options.

Each country or region will have its own solution for its energy needs. We do not see the possibility, or even the desirability, of a single, overall solution. Our present and future difficulties stem very largely from our commitment to depletable energy resources, particularly oil. We see, rather, energy systems being built as a mosaic, each country or region using as many of its own resources as possible and, at the same time, using forms of energy as far as possible in ways which are appropriate to their end use. It is likely that nuclear energy would be much more acceptable and understandable if governments and institutions could present its introduction as part of a general energy plan which showed how the use of electricity fitted into a rational and socially acceptable pattern of development.

Economic considerations are crucial. In both industrialized and developing countries the extent to which any new energy source can be used will depend on how much populations are prepared to pay for it. It has been said that the problem the world faces is not a shortage of energy but, rather, a shortage of affordable energy. It is likely that whatever energy sources are used in the future they are going to be more expensive in real terms than almost any of today's sources. This fact may indeed to the salvation of the industrialized countries which will be forced to make their energy use more efficient. At the same time, this makes the problems of the developing countries even more difficult.

As a consequence an objective of R&D in the energy field is not just the development of new energy sources. It is the development of the least expensive energy sources compatible with other social goals, taking into account all social costs, environmental as well as monetary. In this field, technical and economic objectives cannot be separated.

In the course of our discussions we realized that the following assessments of energy resources are no more than a summary of present knowledge.

As in the case of nuclear energy some of the potential alternative sources must also now be considered in the broader context of environmental, cultural and social concerns.

2. Forms of Energy

New sources of energy cannot be developed in isolation from people's needs which can be categorized as follows:

1. Energy as low grade heat (below 100°C) – the energy we need for heating homes and work places.
2. Energy of higher quality – providing temperatures greater than 100°C for more specific applications (light, motive power), i.e. the energy that is crucial for most industrial and manufacturing processes.
3. Energy in a concentrated portable form (e.g. liquid fuels) mainly for transport.

For northern industrialized countries the amounts of energy used in these sectors are roughly comparable (of the order of 30% for each). There are, of course, wide variations in individual countries: those with cold climates tend to consume more energy in the first category, those with large energy intensive industries consume more energy in the second, and large countries without efficient public transportation systems consume large amounts in the third area. Developing countries in warmer climates with a low level of industrialization consume energy predominantly in the transportation sector. They are thus acutely sensitive to increases in the price of oil.

3. The Role of Electricity

Electricity is usually a secondary form of energy, produced from primary sources such as fossil fuels, hydropower, or nuclear energy. Many of the new energy sources being studied (for instance wave power or photovoltaic cells) are seen as means of producing electricity.

Expressed as cents/energy units, electricity is one of the most expensive forms of heat energy, partly because of the conversion process involved. For instance, fossil-fuel power stations have an efficiency of only 30-40%. With few exceptions the remaining 60-70% of energy produced in these stations is discarded as low grade heat, for example in cooling water, because of the limitations in engineering the steam cycle. Nevertheless, electricity is flexible, convenient and clean at the point of end use. It can be argued that, for the value received, it is remarkably cheap. For these reasons, it is favoured by the consumer, and the demand for electricity

has increased at a rate higher than the demand for energy generally. Electricity is chiefly used in the residential and industrial sectors. In transport its use is largely limited to railways.

4. The Potential and Limitations of Non-Nuclear Energy Sources

a. Conservation

If by any means we can get a job done using, say, thirty percent less energy, that energy saved can be regarded as new energy, which could be used later or could be used today for other purposes. In a very real sense, then, conservation is an energy source.

Conservation has two aspects: thrift, turning lights off when we do not need them, and efficiency, using energy more efficiently by, for example, providing more insulation, using the reject heat from turbines to provide heat for houses.

In many industrialized countries in the recent past energy has been so cheap compared to other factors, such as capital and labour, that energy costs have not been a significant concern; engineering designs have never been optimized to reflect probable long-term energy costs. Many studies have indicated that there is considerable scope for such reductions: a decrease of 1% per year in the U.S. for instance (which does not sound like much) could halve energy consumption in thirty-five years. The rate at which these changes can actually be accomplished depends on the rate at which old equipment can be replaced and this in turn depends on the cost of energy and of capital. The main driving force for these changes will be increasing energy costs which, in this sense, are in the long-term interest of industrialized nations.

b. Hydroelectricity

There are still considerable undeveloped resources of hydroelectricity which, under certain conditions, can be developed in an environmentally acceptable fashion. The environmental effects cannot be ignored. Many projects in North America have been delayed or deferred because of environmental concerns. Further, the undeveloped resources tend to be in remote areas and so the costs of transmission are very high.

The development of local, hydroelectric generators is attracting renewed interest. This type of development has in the past sometimes been ignored because of the favourable economics of large installations and the uncertainties of water storage in small streams.

c. Oil and Natural Gas

Oil and natural gas are the most convenient and favoured forms of primary energy at the present time. They are also the sources which are depleting most quickly. It is anticipated that, over the next decades, there will be an intensive world-wide search for oil, much of it in inhospitable places. The environmental and economic costs will be high and this may limit the development of these resources.

It is hoped that the enormous amount of gas now being flared in the large oil fields can be used in the future. As with so many things, this will only be possible when the price of natural gas in the industrialized countries increases enough to cover substantial production costs. Because of their exceptional value we recommend that strong conservation measures be applied to oil and gas.

d. Coal

The world resources of coal appear to be large but are very unevenly distributed. The quality of coal with respect to its heat content and the amount of sulphur and other pollutants is also variable. The mining, transportation and burning of coal all pose environmental problems. Improved methods of combustion can reduce the contribution to atmosphere pollution and are, indeed, mandatory if there is to be any significantly greater use of coal. The development of fluidized bed boilers and coal gasification are two relevant examples.

The possibilities of major and irreversible climatic charges resulting from the accumulation of CO_2 in the atmosphere is a key problem in the longer term for a all the fossil-fuels; this is now being closely monitored by UNEP United Nations Environment Programme as part of its Earth Watch programme. It is questionable whether the world can rely on an increased and continued availability of coal over a long time (greater than 50 years) as an energy source even though the resource base is very large, because the accumulation of atmospheric pollutants could pose very serious long-term problems. While worldwide coal consumption could be doubled or more, this would take time – perhaps twenty years. For the reasons indicated above many feel that coal consumption should not be allowed to increase above this level, or even increase at all.

Coal can be chemically converted into a suitable form to match most energy needs. Over the next twenty-five years coal and nuclear energy will be two principal alternative means of generating electricity. On this time scale, the use of nuclear energy hinges, therefore, on the need for electricity and both the availability and acceptance of increased use of coal.

e. Solar Thermal Energy

It is technically possible now to provide a large fraction of space and water heating in buildings by the use of solar energy. In many parts of the world it appears to be economic today. Such estimates compare the amortised capital costs of the solar installation over a ten to twenty year time scale with cumulative anticipated fuel costs from alternative sources. Such a calculation depends on the assumed interest rates and the rate of increase in fuel costs. Rapid installation of solar equipment is presently constrained by poor information to consumers, the rate of public acceptance of the technology, its higher first (initial) cost, the rate of turnover of existing equipment, massive subsidies to competing alternative (including existing) sources and various other institutional constraints. It is essential that more attention be given to alleviating these institutional constraints, for example, through tax incentives, demonstration programmes and the removal of higher subsidies for alternative sources. It appears possible and likely that within a fifty year time period about one half of the low grade heat (below 100°C) would be supplied by solar energy. Depending on climatic conditions and other local circumstances, this could amount to 15 to 30% of total energy consumption. Solar thermal energy is an area of much technical interest at the moment; new ideas are being continually advanced on ways in which solar heat could be linked with other energy supplied.

f. Solar-Electric, Photovoltaic Conversion

Solar-electric generation by concentrating the sun's heat to make high quality steam will certainly be capital intensive. Photovoltaic conversion has one very important feature. Today it is expensive and could only be used in special applications. However, of all the new energy sources, it is one of the few where there is expectation that costs could be drastically reduced. If this is successful then there is the prospect of using such a source in a decentralized fashion. Eventually as solar electric takes on a greater share of the demand there will be in addition the need to devise

a suitable cost effective storage capability to provide electricity during the night. This does not appear to be a problem within the next twenty-five years or so, because the market penetration is likely to be slow. However, if suitable, cost effective, energy storage is devised this source has very interesting long-term potential.

g. Wind Energy

Because wind is so variable, wind energy is only useful as a supplement to existing sources of energy where some form of energy storage already exists, or in special applications, such as the pumping of water for irrigation. The basic technology exists. Modest development programmes exist in several countries. Wind energy is not likely to be inexpensive. To be reliable and long-lasting the installation will require high quality engineering.

h. Biomass

Vegetable material can be converted, with existing technology, into a variety of chemical materials and fuels. The potential of this resource is significant (perhaps up to 10% of present energy consumption). It is however, uncertain as to how large a renewable resource biomass represents. There is a large potential from farming the oceans for fuel in addition to existing agricultural, forestry and urban waste. Deforestation is a world-wide problem; the agricultural resources of the world are already dependent on fertilisers and the availability of water and are limited by soil erosion. Noting that wood is already very widely used as a fuel, a further massive use of plant life farming to provide energy in addition to food, may not be as simple and straightforward as it appears at first sight. Studies and the development of these resources are being conducted in many countries: the practical potential should be better known in the course of the next few years. In spite of the reservations it may turn out to be one of the most interesting long-term developments. The use of biogas, on a small decentralized scale, is of interest to developing countries.

i. Wave Energy, Ocean Thermal Gradients, Tidal Power

Except for tidal power these are all solar related technologies generating electricity. They all have the characteristics of high, largely unknown capital costs. Their application, if successful, is likely to be limited. Tidal power is now being used, but it can only be developed in a very small number of areas. There are programmes on the development of wave energy in several countries. Ocean thermal gradients and salinity gradients may, at best, be a long-term prospect. Much further assessment needs to be done.

j. Fusion

Nuclear fusion, like solar energy, has the potential of opening up vast new resources of primary energy. Resource limitation, if any, may not be in the primary fuel (deuterium, lithium) but in the special materials, such as niobium which may be needed in construction.

Following some thirty years of research (started in the 1950's) there is the expectation that, within the next ten years, the scientific feasibility of a fusion device with an energy producing plasma will be demonstrated. This demonstration would not, however, be in any real sense an engineering prototype of a commercially acceptable device. This further step presents formidable technical, economic, and engineering problems. While one can say therefore that a fusion energy device can be built, one can only speculate on its cost and commercial feasibility. It is likely that it would be costly compared to present nuclear installations and may be a large device. A fusion reactor produces significant amounts of new radio-active material in its structure and releases large amounts of tritium. While the amounts of radio-activity are indeed much less than those involved in fission reactors and the half lives are shorter, there will still be the need for radio-active waste management programmes. The excess neutrons in a fusion reactor can also be used to breed fuel for nuclear fission reactors. Fusion will therefore have environmental problems of its own.

k. Geothermal

There are manifestations of geothermal resources in many parts of the world. High grade geothermal energy suitable for electricity generation has been used in a number of countries for a long time. Many countries are developing these sources of energy. The global availability of low grade geothermal energy suitable for agriculture and domestic heating is greater. Further research and development, including exploration, is however required before the full potential of geothermal energy is known.

l. Energy Storage

Many technical problems in supplying energy would be resolved if inexpensive means of storing energy were available. This will probably turn out to be a key problem which may limit the use of solar energy. An inexpensive method of storing electricity would also greatly simplify the problems of electrical utilities and could lead to significant cost reduction. While this is not an insurmountable problem even with current technology, nevertheless the difficulties should not be underestimated.

m. Where These Energy Sources Can Be Used

Looking back to the three general end uses noted in Section 2, we find that there are many ways of providing heat below 100°C for houses and buildings. Electricity can be used directly or indirectly using a heat pump.* The reject heat from electrical generating stations can be used in district heating systems. If geothermal energy is available this can be used in the same way.

For high temperature processes, like smelting of iron, coal will be invaluable. For other sources of high grade heat and energy, electricity will be widely used. Here coal and nuclear energy will be the primary competitors over the next twenty-five years. We will have to wait and see if other sources can be developed.

The use of energy in a mobile concentrated form for transportation represents the most difficult technical problem. Great attention will be paid in the next few years to making synthetic fuels from coal and biomass. In the long-term these processes are all limited by the same general considerations which apply to the direct use of coal. Electrically driven vehicles are receiving more attention. Their widespread use depends on the availability of electricity and the development of energy storage devices, and their economics compared with alternative liquid fuels (e.g. synthetic gasoline or methanol).

n. Priorities in Development

The term priority unfortunately suggests that one thing is to be done before another. As can be seen from this discussion, however, we need and can use many different sources of energy; we also need to know the economic

---

* A heat pump or an air-conditioning system run backwards: instead of cooling the house and heating up the outside air, the system heats the house and cools the outside air. Depending on various factors a heat pump can provide about three units of heat for each one unit of electrical energy used to drive the system.

potential of these resources. Perhaps the highest priority is not technical development itself but the development of plans for these technical changes, plans which, to the extent to which we can afford this luxury, give scope for a wide variety of solutions on regional and national scale.

II. SOCIAL COSTS AND RISKS OF NUCLEAR ENERGY

1. Introduction

To live with risk seems normal to human existence. But there are differences of magnitude and moral quality among various risks.

One can make the distinction between the personal risk taken by a mountain climber and a collective risk imposed upon a whole community by the decision of the few.

There seems to be a threshold of frequency, magnitude and quality of damage beyond which risk-taking becomes questionable. When two planes clash in mid-air and kill a large number of people, the catastrophe, though great, is still finite and understandable. On the other hand, it is not possible to draw such a convenient boundary around a nuclear accident because of the unpredictable nature of long-term genetic effects, sterilizatation of land, and the consequent adverse public reaction which could develop out of a major but isolated nuclear accident. To a number of people this would seem to suggest that extraordinary precautions must be taken to avoid incurring such a risk, and under certain conditions that even a reduced level of risk is totally unacceptable. However in this case the decision must be considered as part of the general accumulation of risk to a community arising from increased dependence on various forms of technology, including the use and availability of potentially hazardous drugs, chemical fertilizers or other equally dangerous materials in common use.

In making a decision for or against nuclear energy as a substantial component of the energy mix used by a nation, some risks are involved whichever decision we take. We find it necessary for Christians and others to ask certain questions and seek answers to them:

1. What machinery is there in the country to make sure that the people who are exposed to the risk understand and accept it?

2. In estimating the risks, have we taken into account at all stages of the process the technical as well as the socio-economic, political and ecological aspects of the issue?

3. If the technical information is insufficient or if the level of technology developed is inadequate, what are the risks involved in postponing the decision to go nuclear, or in adopting a longer time-scale for developing certain types of reactors?

4. Different types of reactors and fuel cycles involve different sets of risks and different possibilities of safeguards against risks. Have these been taken into account?

5. What sort of an energy mix would be required if a non-growth pathway is taken by a society and what are the problems and risks involved?

2. Social Costs

In all decision-making both the costs and benefits of different options have to be taken into acount. This section deals primarily with the social costs and risks connected with nuclear energy, but does not attempt to enumerate or evaluate the possible benefits.

Energy is desired as a means for doing work and improving the quality of human life. The end is a human society that increases the quantum of benefits, and is more just in the distribution of power, wealth and other benefits as well as the risks; which provides for more and more participation by all in decision-making, and affords better protection to a sustainable biosphere.

Social cost is a concept defying precise definition and quantification, especially when it concerns increase or decrease of the quality of the human life made possible by the system of social and political organization, and the cultural and physical environment. It has also to do with the harm or injury done to people by corporate decisions and actions. Remedial measures should be sought to mitigate injustice wherever possible. Some concerns are:

1. The damage from low-level radiation caused by uranium mining and milling, as well as from higher level contamination due to unsafe storage, transport or disposal of radio-active fuel or waste, or to possible reactor accidents, is seldom distributed in proportion to the benefits derived from nuclear energy.

2. The cost and benefits of decisions taken by one generation are often unevenly distributed among other generations, especially if we take into account environmental pollution and genetic damage.

3. The capital-intensive, centralized and large-scale organization necessary for developing nuclear energy has its social costs, especially for labour-rich societies and non-industrial cultures. It may also disrupt the socio-economic infrastructure of certain societies, though the level of disruption may vary.

4. Development of nuclear technology can lead to new patterns of dependence for some, both within a nation and between nations.

5. When the development of nuclear energy is entrusted to private or state corporations, their power over the economy increases and inevitably leads to a greater degree of centralized control over the energy markets.

6. The degree of continuous vigilance required for safeguarding nuclear fuels and reactors may require safety measures that infringe upon personal freedom, including monitoring and infiltrating organizations regarded as potentially dangerous, eavesdropping on the activities of nuclear employees and other members of the public, granting extra powers of search and evacuation of certain areas in an emergency, etc. Such surveillance increases the risk of authoritarian government. Some feel that this danger in relation to nuclear energy is over-emphasized. The issue calls for more detailed and careful discussion.

7. Threats of blackmail or sabotage by using nuclear explosives or contaminants becomes greater with the large-scale development of nuclear energy.

8. The highly technical nature of the issues involved in reactor design and development and in the fuel cycle makes it necessary for the public to rely more heavily on the opinion of the competent few. This demands more complex machinery to arrive at decisions acceptable to the public, and this is an added social cost.

Comparable social costs may apply also to other options offered to a society and should be taken into account in considering these options.

3. Risks

Every industry has certain characteristic risks associated with it and no type of industry for the production of energy is an exception to this rule. The types and magnitude of risk may differ from one power industry to the next and usually it is difficult to make a quantitative evaluation or comparison of the risks. In some cases basic data are lacking and often the kinds of risks are very different.

In any case the comparison is at best very unbalanced because we know far more about the risks from radiation exposure than those from some chemical pollutants. Sometimes the type of fossil fuelled or nuclear plant or its location and associated facilites influence greatly the risk; so a serious effort must be made to choose the best location and the safest type of plant in each individual case. Even before this choice is made a careful evaluation must be made of the energy needs of the community over the next 10 to 40 years. And the need for this electrical energy decades ahead must be balanced against the ecological damage to the community and the environment from the construction and operation of the plant, and against the subsequent damage to the plant's workers and the members of the public.

a. Risks from the Entire Fuel Cycle

In comparing the risks of one type of power supply with those associated with another, the risks from each and every part of one cycle must be compared with those of the other. Throughout this discussion comparisons are made of coal power with nuclear power but similar comparisons could be made with power from geotherm (SH2 Rn-222, etc.), solar conversion (thermal burns), biomass (loss of food producing land), hydro-electric (silting of lakes and damage to the ecosystem), etc.

The risks from tailings at the uranium or processing plants are not strictly comparable with the risks from tailings at coal reprocessing plants. Perhaps the greatest risks from uranium or tailing piles resulted when this material was used in a few cases for land fill in the local communities. This practice is now prohibited in the U.S. and the piles are being stabilized to some degree by covering them with caps of concrete or grassed domes and surrounding them with security fences. Other measures are taken to reduce the leakage from the piles of the radon gas to the atmosphere and the seepage of radium into sources of drinking water.

The risks of shipping coal probably are much greater than the risks of shipping the uranium oxide (U308). In the chemical processing plant (where the uranium is converted to UF6), the uranium enrichment plant (where the concentration of U-235 is increased from 0.7 to 3%) and in the uranium fabrication plant (where the uranium fuel elements are constructed), there are the usual chemical and industrial hazards.

With the exception of atmospheric testing of nuclear weapons the exposure of the general public to ionizing radiation is for the most part attributable to the operation of civil nuclear power plants. For those who are involved in the process occupational exposure during operation and maintenance procedures are the most important factor. This covers exposure to materials removed from the reactors (e.g. fuel elements), and to escaped radionuclides in the environment and internal exposure to radionuclides taken into the blood (by inhalation, ingestion or through the skin). Most of the exposure to date has been to plant workers. Except for a few of the earlier nuclear power plants, the exposure of persons living in the environment close to the power reactors has been quite low (less than 5 mrem per year).

Occupational exposure in the reactor facilities has ranged from the average of 1200 mrem in 1972 to 600 mrem in 1976 while the man-rem dose increased from an average of 340 man-rem per reactor in 1972 to 500 man-rem per reactor in 1976 in the U.S. power reactor facilities.

There are only a few commercial facilities for reprocessing of reactor fuel elements in operation. These are in the U.K., France, Japan and India. The U.S. has postponed indefinitely commercial reprocessing as part of its nuclear non-proliferation policy. So far the record of occupational exposure and environmental contamination has not been good. A good record of safety is yet to be achieved. In the absence of reprocessing, facilities for longer storage of the spent fuel elements would have to be provided.

If nuclear power is to make an appreciable contribution to the world's demand for energy into the next century, breeder reactors may have to be put into commercial operation, and if so reprocessing plants would have to be set into operation to provide the plutonium fuel for the operation of these breeder reactors.

Many persons seem to consider high-level radio-active waste disposal (or disposal of the spent fuel elements from the light water reactor in a once-through cycle) the Achilles heel of the nuclear industry. This problem, seen from the standpoint of those directly involved in the industry, appears, in practice, to be manageable. Some countries (e.g. Sweden) claim to have a practicable solution. The search is for a long-term economic means of high-level radio-active waste management and this is what remains to be demonstrated.

A number of complex research projects, including several now in progress, seek to confirm the safety of different procedures for waste disposal and fuel storage, both in relation to secure casing designs and to the selection of safe geological formations for repository. An operational repository that meets all reasonable requirements may take at least another ten years to develop.

b. Some Fuel Cycle Problems under Study

Some of the nuclear power facilities (reactors and reprocessing plants) are emitting to the environment relatively high levels of C-14, H-3, Kr-85 and I-129. Studies are underway to reduce these emissions in order to reduce the risks of low levels of ionizing radiation for the world population. Perhaps, however, of even greater concern is the release of CO_2 from fossil fuels, e.g. coal and oil-fired plants. Concentration of this gas in the upper atmosphere of the earth tends to reduce the albedo or loss of heat from the earth's surface and so we face unknown changes in the earth's climate that may become very serious as we depend for energy on the burning of fossil fuels during the next 100 years.

One major concern is to improve the present reactors and, if nuclear energy is to continue to make a significant contribution to world energy needs, to make future choices of reactor systems that will provide the proper mix of *minimum pollution, maximum safety,* a *minimum of genetic* and *somatic forms of human damage,* a *minimum proliferation risk,* and *maximum economy.* For example, many believe a long-range nuclear power industry beyond this century depends on the development of breeder power plants. Many persons, however, have pointed out that the liquid metal fast breeder reactor does not score as high on any of these five requirements as certain types of uranium-233 thorium breeder systems that are being considered.

c. Major Accidents in the Nuclear Fuel Cycle

Accidents could occur in the shipping of spent fuel elements and high level waste. Thus there is need for the continuing development of careful plans to prevent and minimize the consequences of shipping mishaps. Atomic bomb-type explosions cannot occur by accident in the fuel reprocessing plants but extraordinary precautions must be continued in these plants to prevent fires, or criticality accidents, or the spread of contamination by structural damage to the plant.

The power reactor is the most likely source of nuclear accidents of varying intensity. Although the worst of such accidents could not be compared to the explosion of a nuclear weapon, it is conceivable that radio-active contami-

nation could be dispersed over hundreds, and perhaps thousands of square kilometers resulting in considerable loss of life, including some immediate deaths but more probably resulting in a localized increase in the mortality from cancer and genetic mutations.

Certainly there will be many minor and relatively insignificant accidents at nuclear power plants, but according to several recent government studies, e.g. the Rasmussen Report by the USAEC, major accidents in which the outer containment of the reactor fails and a large fraction of the radio-active materials escapes can be expected to have an extremely low probability. There may be good reason to doubt some of the assumptions made in the Rasmussen study but even if the risk is 100 times that stated in the Report, the chance of such a major accident is very small and the consequences might be comparable to some past major accidents from floods, earthquakes, etc. It follows in terms of statistical probability that with a larger number of reactors in operation in different parts of the world, the cumulative risk of a single catastrophic accident must increase proportionately. In contrast the nuclear industry would claim that of the accumulated experience from the 206 nuclear power plants presently in operation there has not been a single radiation-induced fatality. The claims on either side of the argument are hotly contested.

The popular debate about risk evaluation is a comparatively recent phenomenon. And in considering the nuclear options in comparison with various other energy alternatives it is essential that proper consideration be given to factors other than operational failure. In particular the problems of economic performance, reliability, flexibility and other demand variables which reflect changes of life style need to be investigated.

Christians have a responsibility to initiate or participate in public discussions which lead to decisions on what alternative energy mixes a society chooses to adopt, with its accompanying risks and consequences. The main problem for many people is to understand that a non-nuclear option has also its consequences and risks in relation to a possible world energy shortage.

The value of one human life can never be estimated in monetary terms. But societies have to make decisions on how much they want to invest scarce resources to ensure safety for all, not only in relation to nuclear energy development, but also in relation to other hazards to which people are exposed.

III. THE DEBATE ABOUT THE BREEDER REACTOR

A breeder reactor is a nuclear reactor that is capable of producing more nuclear fuel – fissionable material – than it consumes during the nuclear fission process. The new fissionable material is created by capture, in fertile materials, of neutrons from the fission process. There are numerous alternative breeder reactor concepts that vary according to the choice of fissionable and fertile materials, the choice of coolant employed to transfer heat from the reactor core, etc. These fundamentally different design concepts lead to different estimates of cost and performance. While several of the concepts – such as the gas-cooled fast breeder, or the molten salt thermal breeder – have their own constituency, all of the industrialized countries having significant breeder reactor development programs have chosen to give priority emphasis to the development of the liquid metal fast breeder reactor (LMFBR) over these other concepts. The discussion that follows focuses on the commercial development of the LMFBR and any reference to the breeder or the fast breeder, unless otherwise stated, is meant to imply the LMFBR.

Several industrialized countries have experimental or commercial demonstration LMFBRs, maintaining the option to proceed further, and mostly supporting a substantial R&D program, viz. USA, U.K., France, Germany, Japan, USSR. France, FRG, Belgium, Netherlands and Italy have entered into a cooperative agreement to share the development of the LMFBR and its future marketing.

The LMFBR strategy in most countries is opposed by segments of the population on a variety of ethical, technical and economic considerations. These are hotly debated and the position for future development is highly fluid. The proponents focus their arguments on the need for the reactor, the opponents on the risks involved and the bad choice of the LMFBR as the breeder to commercialize.

The development of the LMFBR even as a civil demonstration plant actually leads to the consideration of many factors, including, for example:

1. The need for the breeder, the timing of its development, and the cost of the reactor and its fuel cycle.
2. The effect of the LMFBR on the proliferation of nuclear weapons.
3. The extent to which LMFBR development forecloses alternative options.
4. The safety of the LMFBR and its fuel cycle.
5. Whether development of the LMFBR increases the gap between the rich and the poor.
6. Whether it is the best use of resources to achieve a commercial breeder economy in 50 years time.
7. Whether it is possible to separate the R&D from commercialization consideration.

5. The literature is rich with discussions of these issues. Any short discussion here can barely, if at all, do justice to them. Nevertheless, we attempt to highlight a few of the central issues that are part of the breeder debate.

1. The Need for the LMFBR

The issue of need really addresses three distinct questions:

First, should we continue to rely on nuclear fission as a source of energy? The breeder shares many benefits and risks that are common to all nuclear reactors, e.g. concerns over reactor safety and waste management. If one continues to rely on nuclear power, then a second question arises, namely, do we rely primarily on the uranium-235 in natural uranium as the fissionable fuel, or do we rely on breeding additional fissionable fuel – urarium-233 and plutonium-239 – from fertile materials – thorium-232 and uranium-238. Reliance primarily on uranium-235 from natural uranium has certain advantages with respect to limiting the proliferation of nuclear weapons, (see discussion beginning next section) but it implies that nuclear fission is only an interim energy source. Since only 0.7% of natural uranium is the fissionable isotope uranium-235, fission reactors without breeding will eventually become uneconomical as natural uranium resources are depleted. If breeding additional fissionable fuel is desirable now, or eventually, a third question arises, namely, is the appropriate reactor choice the LMFBR? If one opts for development of a breeder, the central issue remaining is what is the best breeder reactor development strategy.

While it is useful to separate these three questions, as in the discussion below, they often become intertwined as arguments for and against the LMFBR are put forward.

It is generally agreed that the world needs new energy sources (particularly renewable). The breeder appears extremely attractive in that it offers a source of abundant

energy beginning in the next century.* Existing commercial reactors can utilize as a fuel only about one percent of the uranium found in nature. The breeder is thought to achieve at some future date, an increase in fuel utilization of a factor of 50 or more, over that obtained by currently used commercial reactors, an advantage that is not unique to the LMFBR but held by all breeders. This necessarily requires the reprocessing of fuel from thermal and fast reactors. A secondary argument for the breeder is that the breeder reactor is the best place for and best use of plutonium from a thermal reactor program.

The arguments in favour are said to make the breeder look more attractive than is the case. The breeder when introduced must be seen to compete at some stage with thermal reactors. The major component of the cost of power from nuclear plants is the capital cost of the plant itself and not the cost of the fuel. The LMFBR (as well as other breeder concepts) is generally considered to have a higher capital cost than existing nuclear reactors. At today's uranium price the LMFBR cannot compete with existing commercial thermal reactors and must await or anticipate only rising uranium prices in the near future. These realities have led to considerable debate concerning the appropriate timing of the commercial introduction of the LMFBR. The debate is difficult in that development times are long, 15-30 years, and there are large uncertainties in critical economic factors.

9. Arguments in support of the LMFBR now favour (a) insurance against rising uranium prices and (b) energy independence. The support for a demonstration plant now (i.e. 1978/1982 start) is linked with current industrial/technical capability which will deteriorate. It has already suffered from a 5-10 years delay. Furthermore, it is argued that if a uranium fuel crisis does arise, circa 1985, a crash programme would then have to be initiated.

Some opponents would like to phase out reliance on nuclear power altogether and therefore oppose the LMFBR. Others, including some who are not opposed to the use of fission energy, suggest that other nuclear fuel cycles are preferred over the LMFBR from the standpoint of nuclear weapons proliferation. For example, some LMFBR opponents foresee the possible need for reprocessing at some later date, awaiting adequate technical and institutional arrangements to safeguard the operations against diversion of weapon usable material. But here it is argued that rather than introduce the LMFBR, an advanced converter reactor, e.g. operating on the isotopically denatured U-Th fuel cycle, would be preferred. For example, a heavy water reactor with this fuel could demote any economic incentive to shift to the LMFBR beyond the middle of the next century. It is claimed that this line of development would be economically attractive and proliferation resistant. These claims are subject to considerable debate, having uncertainties not qualitatively different from the uncertainties around the LMFBR development.

A refinement of the above alternative is to stockpile uranium and continue to use an improved once through cycle with thermal reactors for a longer period. It is said that current fuel cycles can be modified to increase the efficiency of uranium utilization by a factor of upwards to 1.5 without reprocessing and recycling of the plutonium and upwards to 1.7 to 5 assuming recycling but operating on the denatured uranium thorium fuel cycle. Thus it is argued that alternative advanced reactor strategy based on sequential development of more efficient reactor fuel cycles can be developed more cheaply and rapidly than the LMFBR and these are less risky from a nuclear weapons proliferation standpoint. Reactors claiming this prospective are the heavy water reactor (e.g. the Canadian CANDU reactor) and the high temperature gas-cooled reactor (HTGR). Up to this point the argument is about the preference for a once through fuel cycle – no fuel reprocessing – because of a priority concern over nuclear weapons proliferation. A counter argument foresees difficulty in the storage and management of spent fuel. It is also suggested that the political pressures applied by those having uranium will be unacceptable and their promises not credible over a 50 year period.

Hence the choices lie in part among assessments of the need for nuclear fission, the need for an advanced reactor of some type, the respective proliferation risks of different reactor types, political realities and the relative weight given to insurance of energy supply and proliferation.

2. The Effect of LMFBR Development and Commercialization on the Proliferation of Nuclear Weapons

There is a consensus that the vertical arms race between the super-powers is the paramount nuclear proliferation concern. The failure of the super-powers to make any significant progress towards nuclear disarmament is deplorable. Nevertheless, the link between nuclear weapons proliferation and commercial nuclear programmes is extremely serious and cannot be ignored. In this regard recent concern has focussed especially on efforts to commercialize nuclear fuel reprocessing for the recovery of plutonium and efforts to commercialize the plutonium breeder reactor.

Civil nuclear reactors do not directly produce weapon grade plutonium in the spent, or partly used nuclear fuels. However if spent nuclear fuel is reprocessed it opens the possibility that plutonium may be diverted for weapons purposes. Reprocessing of the nuclear fuel is essential for a conventional breeder programme. Conventional thermal reactors do not require reprocessing as long as uranium fuel is available. The proliferation problem associated with the breeder is not unique to the breeder, but follows from the requirement of reprocessing.

To place this proliferation problem in perspective we make the following quantitative observations:

- A nuclear weapon comparable in yield to those dropped on Japan, requires approximately 5 kg of weapon grade plutonium.
- The nuclear fuel inventory (1000 Mw) commercial site LMFBR contains approximately 3000 to 5000 kg of plutonium in the form of mixed oxide fuel. Annually, approximately one-half of the reactor fuel, containing 1500 to 2500 kg of plutonium, is removed and shipped to a fuel reprocessing plant where the plutonium is recovered, subsequently to be refabricated into new nuclear reactor fuel.
- A commercial-size (1500 MT/yr) fuel reprocessing plant will recover annually sufficient plutonium to construct several thousand nuclear weapons.
- In a future world economy of 1000 LMFBRs annually several millions of kg of plutonium (enough for several hundred thousands atomic bombs) would be removed from these reactors and flow through the nuclear fuel cycle. This plutonium would be vulnerable to theft or diversion at the dozen or so reprocessing facilities, the fuel fabrication facilities, and during shipment between reprocessing and fuel fabrication facilities and between the fuel fabrication facilities and the reactors.

There is not a single view as to whether reprocessing and the commercial introduction of the LMFBR significantly

---

* It should be emphasized that abundant energy will not lead to cheap energy and most future forms of energy are in use.

exacerbate the current risks of proliferation of nuclear weapons. Proponents of the breeder would point out, for example, that the net annual plutonium production by an LMFBR is not appreciably different from today's commercial thermal reactors.

The horror story of widespread proliferation presented above is misleading because the plutonium is located at a limited number of reactors and fuel facilities – many in nuclear weapons countries, or highly industrialized countries that could readily acquire nuclear weapons by other routes if they chose to do so. The real issue is whether to reprocess and recover plutonium from nuclear fuel. The present alternative to reprocessing – indefinite storage or disposal of spent fuel from today's thermal reactors – would produce "plutonium mines" and represent an unacceptable safeguards hazard and legacy to future generations. Furthermore, reprocessing plants already exist and some countries have fuel reprocessing and plutonium breeder programmes and will continue them.

On the other hand, opponents of the breeder argue that once reprocessing is sanctioned, large flows of recovered plutonium – "plutonium rivers" – and plutonium stockpiles will become a world-wide reality. This is particularly true of the LMFBR where one-half of the large plutonium inventory in the reactor (not just the net production) is reprocessed annually. As a consequence of the commercialization of plutonium reprocessing, the civilian nuclear power programme would provide a shorter route to the acquisition of nuclear weapons than the construction of facilities specifically designed for this purpose.

According to this line of argument the reprocessing of spent fuel and the recycling of plutonium (or any other weapons material such as highly enriched uranium or uranium-233) in fresh fuel for reactors would allow non-nuclear weapons states to acquire and stockpile material usable for nuclear weapons – seemingly for peaceful purposes.

Without violating any of the international safeguards agreements, they could design and fabricate weapon components and move to the point of assembly – leaving only the final stages involving the introduction of fissile material. In such circumstances the non-nuclear weapons states would have all options open. International safeguards agreements would serve as a cover for nascent weapon states; concealing the signs of critical changes until it is too late for diplomacy to reverse a decision to "go nuclear".

Even the acceptance of the plutonium breeder as an energy option, it is argued, provides the justification for the early development of a reprocessing capability by any country. At the moment, it is argued, reprocessing facilities lack that legitimacy, given the marginal economics of reprocessing and recycling for today's reactors. These opponents share a strong doubt as to whether commercial size reprocessing plants or mixed-oxide fuel fabrication plants can ever be subjected to effective international safeguards – that is, safeguards which provide a high probability that diversion of weapons material can be detected in a timely fashion. In any case a non-nuclear weapons country would always have the option to shift its "peaceful" nuclear programme to a weapons programme. Countries having national reprocessing facilities and breeder reactors could therefore circumvent the very considerable political problems and costs inherent in building one or more plutonium production reactors otherwise necessary for the production of large quantities of weapons grade plutonium by establishing their nuclear weapons option through their nuclear electric generation programme.

Many of these problems were recognized almost immediately when the problem of nuclear weapons proliferation was first analyzed at the end of World War II. Thus the central conclusion of the Acheson-Lilienthal Report on the International Control of Atomic Energy published in 1946 was that:

> *"We are convinced that if the production of fissionable materials by national governments (or by private organizations under their control) is permitted, systems of inspection cannot by themselves be made 'effective safeguards... to protect complying states against the hazards of violations and evasion'."*

A conclusion to this argument is that reprocessing and the commercialization of the plutonium breeder should, if not banned altogether, at least be delayed until effective safeguards could be implemented, if this were ever possible.

Breeder advocates, on the other hand, have argued: (i) that nuclear weapons proliferation is an international political problem that should be dealt with politically, not by restricting the course of nuclear power development; (ii) that there already exist many opportunities for a determined large group or nation to obtain weapons usable material, e.g. from research reactors; (iii) that if necessary, the breeder fuel cycle can be made more proliferation resistant than the version which was originally proposed and in any case, as noted above, (iv) the alternative of producing "plutonium mines" is unacceptable. A consequence of this line of argument is that the abundant energy resource provided by the breeder should take precedence over proliferation considerations.

To each of the above arguments there are counter claims. For example, the argument that nuclear weapons proliferation is a political problem is based on the undeniable proposition that there is no "technical fix" that would prevent the spread of nuclear weapons. A nation could, for example, acquire modest amounts of weapons usable material through a relatively inexpensive programme dedicated to the production of these materials. A dedicated programme, however, would require an explicit commitment to the manufacture of nuclear weapons and for most nations would take years to bring to fruition. By contrast, plutonium routinely separated out of spent fuel for nominally civilian purposes could be rapidly converted to nuclear weapons use following a decision to do so. As a consequence, the deployment of plutonium-based nuclear power technology would greatly increase the risk of proliferation "in the heat of the moment".

In answer to the argument that there are presently other means for obtaining materials usable in weapons, it may be said that we should strive to close all the loopholes rather than open others.

3. The Safety of the Fast Breeder Reactor (FBR) and its Fuel Cycle

If the policy of keeping all options open is to include the future development of the FBR, then its safety must be established. The safety of any system, including LWR, is now looked at more carefully and there is a demand for a continued lowering of the risk. Several studies on the breeder, including that of the Royal Commission on the Environment (U.K.), have recognized residual problems which, it is generally agreed, need to be resolved before a commercial breeder programme is launched.* Demonstration plants already exist in a number of countries and the effort required in their design/building and support research has clarified some, but not all, of the safety issues. In most countries there is not yet agreement on whether this is sufficient to justify building a commercial plant.

---

* For a more extensive technical discussion of the safety issues, the reader is referred to paragraph 297-304 of the *Royal Commission on Environmental Pollution*, Her Majesty's Stationery Office, London, 1976.

It is recognized that the problems of the LMFBR are different from those of the thermal reactors and the lack of clarification of these issues has led some people to fear that the former may be potentially uncontrollable under some conditions. The LMFBR cannot have a commercial future unless these issues are resolved and the public satisfied by the evidence.

The breeder fuel cycle also requires more advanced technology than the thermal reactors. The practicability and safety of this cycle have still to be demonstrated.

Will the Rich get Richer?

The LMFBR represents a capital intensive, high technology which requires an extensive industrial base and a highly trained cadre of experts for its proper operation. It is being developed primarily by a few industrialized countries. It is often suggested that instead of providing resources to better the lives of the poor it will simply be a tool of the rich, resulting in more consumption, more waste, and further widening the gap between the rich and the poor. The haves will have more, the have-nots will have less. The poor countries will see that the rich are going further in a direction they cannot follow. Furthermore, the development of the breeder could exclude the possibility of other options – specifically the solar route – so that technologies more appropriate to developing countries are neglected. The expenditure by some countries on the breeder as compared with their expenditures on other options would seem to deny their expressed concern for the poor even though from their own point of view such a balance may be logical. It has been suggested by some that the breeder technology can make a direct contribution to the energy system of developing countries. We do not believe this could be effective for at least 50 years. It is also argued that if the breeder were used in developed countries this could release other resources to be used elesewhere. Such an argument is questionable. There is no guarantee that resources released by the rich would be available to others. Economic factors intervene and there is no readily available institutional way of transferring resources from one country to another, though arrangements should be made to encourage such transfer.

In any evaluation of the preceding arguments the following questions need to be considered:

- Will curtailment of the LMFBR programmes necessarily benefit the poor countries?
- Are there other types of breeder systems that would be safer and reduce proliferation risks?
- To what extent does the development of alternative energy options by the rich countries benefit or harm the poor ones?
- To what extent would cancelling the breeder lead rich countries to find solutions which suit both their needs and those of the poor? (e.g. the solutions which suit tropical or rural communities may not suit northern industrial communities and vice versa.)

IV. NUCLEAR POWER AND NON-PROLIFERATION

Among the various risks connected with industrial utilization of nuclear power, the possible diversion of fissionable material for use in atomic weapons is different from many others. A country by abstaining from nuclear power can reduce to zero the risks of operational accident, waste disposal and economic performance, but proliferation of nuclear weapons can be effectively controlled only by international cooperation. Five categories of proliferation are of concern:

1. *Vertical proliferation* – where nuclear weapon states add more weapons to their arsenal. When this happens it becomes more difficult to deny non-nuclear weapons states the right to acquire them.
2. *Horizontal proliferation* – where countries without nuclear weapons acquire them. To reduce the chances of this at least three problems have to be considered: a) the political incentive to have nuclear weapons; b) the technological know-how and capability to fabricate them; and c) safeguards on fissionable materials.
3. *Latent proliferation* – where a country builds up the capacity to construct nuclear weapons and maintains a readiness to do so, but stops short of actual production for the time being. Strictly speaking this would violate the spirit but not the letter of the NPT.
4. *"Subversive" proliferation by sub-national groups* – where groups other than national governments acquire their own nuclear weapons, possibly through the theft of fissionable materials in plants or when transported between plants. This raises questions about methods to prevent theft, adequacy of monitoring techniques for its detection, and the impact of increasing security measures on civil liberties.
5. *Revolutionary proliferation* – where nuclear weapons belonging to a nuclear power are taken over by other authorities following a seizure of power.

Although the dividing line between military and civil uses of nuclear power will inevitably become obscure where there is a breakdown of constitutional government, whenever it is decided to embark upon civil nuclear power programmes the strategies and military implications of such decisions cannot be avoided.

For a long time it was assumed that by every possible means the proliferation of nuclear weapons should be prevented, e.g. by prohibiting additional states having access to them. It was postulated that the fewer the decision centres that could command the use of such weapons, the smaller the risk that such weapons would be used. Considering the consequences of a nuclear war, non-proliferation of all types was a top priority concern for mankind. The debate was about how this can best be achieved.

Today the debate has changed because more states have now acquired the potential of making nuclear weapons and it is clear that stopping further proliferation requires both new approaches, and the adaptation of existing treaties and agreements to changing circumstances at all levels ranging from the international governmental level to the level of individual construction contracts.

1. International Treaties and Regulations

A number of international arrangements and other initiatives have been instituted to limit the proliferation risk, e.g. bilateral agreements on assistance and on the preaceful use of atomic energy with related trilateral safeguards agreements with the IAEA.

a. Responses Within the Framework of the Non-Proliferation Treaty (NPT)

The essential provisions of the NPT, as originally formulated, incorporate the following concerns:

Art. I. Nuclear powers shall not transfer nuclear weapons to anyone.

Art. II. Non-nuclear powers shall not acquire nuclear weapons.

Art. III. Prescribes the application of IAEA safeguards 1) all nuclear activities for peaceful purposes in non-nuclear weapon states parties, and 2) on

all fuel and equipment exported by parties to non-parties.

Art. IV. Permits the full sharing of peaceful uses of atomic energy among all parties.

Art. VI. Prescribes that the nuclear weapons powers shall negotiate to stop the nuclear arms race and commerce nuclear disarmament.

In practice a difficulty has arisen because of an ambiguity in the interpretation of the NPT. On the one hand, Art. IV states that signatories are entitled: "... to participate in, the fullest possible exchange... for the peaceful uses of nuclear energy". This would seem to assure access to nuclear technology. On the other hand, Art. I and II of the Treaty impose on all nuclear weapon states the obligation to refrain from activities that could assist in the spread of nuclear weapons. Some nuclear supplier states insist that Art. IV must be read and interpreted in conformity with Art. I and II (and, in fact, Art. IV says this) and that the Articles should not be considered in isolation. Much then depends on which Article is given priority.

As regards the effectiveness of IAEA safeguards, they are designed to provide a reasonable degree of assurance that the inspected state is carrying out its NPT obligations. In 1976 and 1977 the Agency's operation did not detect any diversion of a significant quantity of nuclear material, and the Agency is able to confirm that, in the 40 countries where safeguards were applied, all safeguarded nuclear material remained in the declared peaceful nuclear activity or was otherwise adequately accounted for.

Further, a number of weaknesses and limitations of the NPT system have now been defined: the failure of many states to become signatories to the Treaty; the ease with which states can withdraw from the Treaty; the loopholes with respect to peaceful nuclear explosions; the handing on of materials to a third state; the practical problems of maintaining safeguards through monitoring and other operational controls; the deficiencies in accounting and warning procedures, especially the inability to detect the diversion and subsequent accumulation of small amounts of fissionable material.

b. The Nuclear Suppliers' Club Approach

As part of the international activities to achieve better methods to prevent a further spread of nuclear weapons technology, and on initiative of the U.S. Government, a group of seven industrialized countries met in consultation in London in April 1975, to coordinate export policies for sensitive nuclear materials and technology. The guidelines worked out by this group, have been published in January 1978. In the meantime 15 supplier countries have adopted these guidelines (USA, USSR, Great Britain, France, FRG, Canada, Japan, Italy, Belgium, Netherlands, Sweden, Switzerland, Poland, Czechoslovakia and the GDR). These guidelines going far beyond the regulations of the NPT are recommended for use by all countries and call for safeguards and physical protection according to IAEA regulations and recommendations.

Outside criticism of the suppliers' group's procedures has encouraged them to make information available through the IAEA; and recently there have been newspaper reports describing the guidelines that are now being applied to the export of sensitive materials and technologies. The latter include: the processes for uranium enrichment and plutonium recycle, along with production and refining of heavy water.

c. The Partial Test Ban Treaty of 1963

This was explicitly to halt the development and atmospheric testing of weapons by the nuclear powers. And also guaranteed the security of their weapon designs. Underground testing of nuclear weapons has also, to some extent, perpetuated this arrangement. The value of this arrangement has subsequently declined as information concerning the design and construction of nuclear weapon assemblies has become more widely available through reference to government publications and the open scientific literature.

d. Nuclear Weapons Free Zones with IAEA Safeguards Applied

The Latin American zone is the only example at present. Other proposals have been made for other regions of the world. One of the problems that comes up in such negotiations is whether the definition of a weapons free zone should necessarily exclude weapons already deployed in delivery systems, such as nuclear submarines, and how such a definition could be enforced.

e. The International Nuclear Fuel Cycle Evaluation Programme (INFCE)

Initated by the United States government in 1977, this is a series of studies, participation in which is open-ended (some 40 countries and three international organizations take part), on all aspects of the nuclear fuel cycle. INFCE's working groups deal with fuel and heavy water availability, enrichment availability, assurances of long-term supply, reprocessing and plutonium, fast breeders, spent fuel management, waste management and disposal, and advanced fuel cycle and reactor concepts. While the IAEA provides meeting services and in some cases a technical secretariat for the working goups, INFCE is an autonomous undertaking, the work of which is expected to be completed by the end of 1979. It is hoped that this evaluation will raise the level of awareness and concern for the proliferation, explore various technical and institutional mechanisms for dealing with the problem and perhaps reach consensus on solutions to problems such as spent fuel and plutonium management.

f. Regional Fuel Centres

The IAEA and some governments have carried out detailed feasibility studies on regional fuel centres which take account of the technological, economic, environmental and security matters. Studies are also underway on plutonium storage. As yet the political and the institutional structures available have not been able to demonstrate the international solidarity and collaboration necessary for this venture to succeed.

In a paper presented to the 1977 IAEA Conference on Nuclear Power and the Fuel Cycle, the World Council of Churches expressed support for the international control of sensitive areas of the fuel cycle, i.e. regional fuel cycle centres and international storage of plutonium. These moves could then be seen as an alternative to a policy of unrestricted access, or denial, or severe restrictions on the transfer of these technologies. The latter policy seems neither desirable from the point of view of non-discrimination nor likely to be effective. History has shown that a policy of restricted access can only delay, rather than prevent, the spread of nuclear technology.

g. The Inevitable Risk of Proliferation

From this short review it is already sufficiently clear that an immediate priority governing the widespread use and availability of civil nuclear technologies must be the introduction of more measures to reduce proliferation risks. Even if nuclear power were to be completely abandoned, there would be a large residual risk of proliferation, and the possibility of a nuclear war from the existence of nuclear weapons states and the political will which sustains them.

2. National Attitudes to Non-Proliferation

a. The Nuclear Super Power: USA and USSR

The Atoms for Peace programme came about during the presidency of General Eisenhower. It was based on the idea that nuclear power could be shared for peaceful purposes and would open up new possibilities for economic development and the use of this technology for the benefit of all peoples. At that time (1960) this progamme was widely endorsed by church people and by such ecumenical bodies as the National Council of Churches in the U.S.A. A few notes of caution were raised, but basically, Atoms for Peace called for a transfer of nuclear energy from government control to private enterprise and from the United States to other nations desiring such technologies.

In the aftermath of World War II it seemed inconceivable that this technology would be diverted from peaceful uses into armaments. Moreover, it was assumed there would be little danger of the spread of nuclear weapons capability, especially since the fuel enrichment and fabrication processes remained in the hands of the two super powers. The safeguards provided by the Non-Proliferation Treaty of 1968 offered additional assurance against the dangers of nuclear weapons proliferation.

The rapid development of nuclear weapons capability in the Peoples Republic of China had already caused concern to those who had assumed that their monopoly of nuclear weapons would last. The development and testing of a single nuclear device in India in 1974 demonstrated the weakness of the current understanding of the use of transferred nuclear technology. This was followed by proposed sales of nuclear fuel reprocessing plants to South Korea, Pakistan and Brazil. These developments have produced the increasing anxiety over the spread of nuclear weapons capability and the fear that the unguarded transfer of nuclear technology was to a large extent responsible.

During the last four years we have therefore witnessed a reversal of attitude on the transfer of nuclear technology and a sharp tightening of controls for fear of contributing to nuclear weapons proliferation.

The first step was to tighten up on the application of the safeguard provisions of the Non-Proliferation Treaty (NPT). The second was to form the Nuclear Suppliers Club designed to assure cooperation between suppliers in East and West in the control of the sensitive nuclear technologies, particularly those relating to production of strategic weapons material. The third step was for the USA, the world's largest supplier of enriched reactor fuel, to restrict the sale of reactor fuel to those countries who were not prepared to accept the formal conditions of the NPT and informal constraints of the Suppliers Club. This restriction was finally embodied in law by the 1978 Nuclear Non-Proliferation Act. As President Carter explained: "We and the other nations of the world must use the time we now have and pause to develop safer technologies, better institutional arrangements, and improved safeguards which will permit all nations to achieve their energy objectives while preventing the spread of nuclear weapons."

As a further consequence this has also led to a substantial review of schedules for the introduction of reprocessing and the establishment of a fuel cycle based on plutonium recycling. The hope is that this will lead to the extended use of existing converter reactors, i.e. light water reactors, heavy water reactors, high temperature gas-cooled reactors and other systems operating on the once-through fuel cycle, that is without reprocessing, postponing indefinitely "incurring new proliferation risks", and allowing time for further investigation.

From a foreign policy standpoint this was intended to influence other countries faced with similar decisions over the expansion of reprocessing plants (e.g. France and the U.K.). So far this has only been partially successful. France and the U.K., for example, have resisted this initiative and have made decisions in favour of the construction of further reprocessing facilities. Japan has also set up an experimental reprocessing plant.

b. Other Nations with Nuclear Power Programmes

A nuclear industry has been developed in some countries which do not maintain a nuclear weapons system and have definitely renounced the possibility of doing so. At least eight countries have uranium enrichment capability, but others are dependent on the USA or USSR for enriched fuel. As national markets for nuclear power plants are usually too small compared to the capacity of the nuclear manufacturing industry in these countries, they have to export. Especially during the last three years several contracts with developing countries have been signed which confirm the movement towards external markets. In order to avoid unnecessary risks of proliferation, all these countries participate in the Nuclear Suppliers Group.

It is felt that neither the rules of this group nor the NPT will give a long range security against the further uncontrolled spread of weapon technology. On the contrary their restrictive policy will bring more and more countries to the conviction that only their own development of such technology, or its development jointly with other developing countries, will assure the desired political independence. This could mean a bypassing of the international control organizations.

It is felt that a close cooperation on all working levels between industrialized and developing countries during the process of setting up nuclear installations or transferring and developing nuclear technology has the following advantages:

- Additional security against proliferation due to the close personal contact of representatives of the partners.
- Better manpower formation possibilities by active participation of the receiving personnel in the preparatory work going on in the donor country.
- Long-term cooperation with mutual participation in the further development.

The disadvantage in this model is the fact that the cooperation cannot be completely open and that certain fields of knowledge have to be handled in a restrictive way, thus creating a climate of distrust.

In Australia the issue of proliferation was raised in the debate over whether to mine and export uranium as a result of the Environmental Commission on Uranium Mining. The Report of the Commission concluded that: "The nuclear industry is unintentionally contributing to an increased risk of nuclear war. This is the most serious hazard associated with the industry."

The churches and other groups in Australia who argued for a moratorium on uranium mining have used this as one of the arguments – that uranium mining should be delayed until and when an international safeguard system can be found that can be judged adequate.

c. Nuclear Power Programmes in Developing Countries

Within the coming decades nuclear power may play an important role in some developing countries. Often such countries have limited indigenous fossil fuel resources and in recent years have been adversely affected by increases in world oil prices. At present, only five developing countries

(Argentina, Korea, Taiwan, India, Pakistan) have nuclear plants in operation. Twelve other developing countries have nuclear power reactors under construction, ordered or planned for operation by 1985. On current projections this number is expected to increase to about thirty developing countries by 2000. The discovery and exploitation of uranium on their territories in several developing countries have led some governments of these countries to propose the building of their own uranium enrichment facilities. The motivation of these countries can be broadly described as follows:

i. They seek access to a range of technologies in order to overcome poverty and to improve the health and social welfare of their populations. Access to and subsequent use of nuclear technology may allow these countries to determine the shape of their own energy policies without these being imposed through external forces, such as those governing the world oil market.

ii. Within the general case of technology sharing, the role of nuclear technology is currently only of minor importance. The main point is that in general technology should be shared with the developing countries according to the needs as defined by the countries themselves.

iii. Based on past experience the readiness of industrialized countries to share particular technology has been limited in practice.

In addition to the above more general considerations, developing countries seeking access to nuclear technology may be subject to more specific influences:

Economic considerations may oblige a country to insulate itself against rising oil prices by spreading the energy supply base and by incorporating the nuclear power option. This will only be possible where the growth of demand coupled with the availability of capital investment allows the country to opt for a national nuclear power system. For smaller developing countries, it would appear that regional collaboration will be necessary to satisfy the investment criteria. Regional collaboration inevitably presents difficulties of a political nature and should, nevertheless, be encouraged. Above all, the developing countries do not want to become isolated from the world-wide technological development and are aware of the often considerable lead times in implementing an advanced technology such as the nuclear technology.

As long as there are countries with nuclear weapons or having the potential to develop them, whether members of the Nuclear Club or adjacent states with nuclear power systems, a developing country may, understandably, wish to retain the right of access to nuclear technology.

Some developing countries may be developing their civilian nuclear programme with the military option clearly in mind. To some the development of a nuclear explosive device may seem to demonstrate a great technological achievement. An alternative view is that this represents a further misuse of technology and a distortion of priorities.

For historical reasons, many developing countries which have had bad experiences with the industrialized countries, have a deep-rooted fear that as the non-renewable resources become depleted elsewhere there is again the threat of resource domination from outside these countries with its obvious political consequences. This fear will only be allayed if industrialized countries are prepared to share the technologies which imply a full sense of participation for their use and deployment.

Conclusion

Whereas the developing countries always oppose any externally imposed constraints on their access to technology, including nuclear technology, they realize that the welfare of mankind is best served by mutual negotiations. These negotiations should be conducted as open-ended negotiations on the subject of sharing of sensitive nuclear technology, such as e.g. know-how about the complete nuclear fuel cycle, all for the benefit of the international community.

From the perspective of most of the developing countries the NPT and other measures for non-proliferation endorse and legitimize the present state of affairs conferring a special status of superiority in power and prestige on nuclear weapon states. While ignoring the solemn promise in Art. IV of NPT, about the cessation of the nuclear arms race, the nuclear weapon states have been making rapid advances in the quantity and quality of nuclear weapons. This has become the biggest obstacle to non-proliferation.

The NPT does not ensure the non-proliferation of nuclear weapons. It only attempts to prevent their spread to non-nuclear weapon states. There is an obvious imbalance between obligation and benefits in the NPT. The Treaty is discriminatory in regard to safeguards and controls, all of which are imposed on the non-nuclear weapons states while none whatsoever are imposed on the nuclear weapon states. The formation of the group of suppliers of nuclear materials and equipment is an admission of the failure of NPT to establish an effective non-proliferation regime.*

While continuing to demonstrate perceptions that nuclear weapons have a high political and military utility, the nuclear weapon states have not been prepared to give an assurance to non-nuclear weapon states that the weapons these states have renounced would not be used against them.

3. Six Possible Positions on the Proliferation Issue

The following positions are identified as options advocated by particular groups. The Consultation was unable to agree on a specific position.

The first three positions start from a national perspective. The last three reflect an international starting point. The positions are not necessarily mutually exclusive. Different mixtures are possible. Each position is briefly outlined and criticized.

Position 1. Reducing Proliferation by Stopping Nuclear Energy

This is the position of the anti-nuclear movement, including those in nuclear power countries who advocate phasing out nuclear power over time, those in non-nuclear power countries who advocate avoiding the nuclear option, and those who see nuclear power only as a last resort. The potential for all forms of horizontal proliferation of nuclear weapons arising from the nuclear fuel cycle is the critical target of this position. Bypassing the nuclear option and making use of alternative energy sources would avoid proliferation and other problems. In many countries there are national movements working towards these ends.

---

* The American light water reactor is easily safeguarded; the Canadian nuclear power plant requires more complex safeguards and more inspections, but this matter is the object of common research between Canada and the IAEA. The installations that pose more serious technical problems are large reprocessing and enrichment plants. Accounting for material in these plants depends partly on the accuracy and precision of measuring instruments. If the plant is large enough, an uncertainty of one percent in closing the balance of accounts could conceivably cloak the loss of a significant quantity of plutonium or enriched uranium. Materials accountancy is, therefore, not sufficient to give the assurance we need in such cases.

Criticism

While not questioning the sincerity of such groups their credibility for some, particularly those from non-nuclear developing countries, will depend on their ability to alter the nuclear drive, both military and civil, in the nuclear countries. Stopping the development of civil nuclear power programmes will not inhibit horizontal proliferation. There is little tangible evidence that this group has assessed the social cost of rejecting the nuclear option. What evidence can convince opinion in the non-nuclear countries that those who hold the anti-nuclear position will succeed in persuading governments to forego the nuclear option? On what grounds can they expect to mobilize opinion in the nuclear countries in opposition to programmes already committed? The answers to these questions are far from convincing.

Position 2. Moratorium Approach

A call for a moratorium has emerged in many industrialized countries. The time period considered is usually 3-5 years.

Three reasons are given for this position: there is need for full public discussion on the energy future in general and on the role of nuclear power. Time is needed to assess and ascertain the security of various aspects of the nuclear system, e.g. radio-active waste disposal; time is also needed to rethink conservation schemes and to evaluate renewable and other energy resources and technologies. In addition advocates of a moratorium argue that present safeguards are inadequate to prevent proliferation. They argue that a fair and effective international safeguards system needs to be devised before any further large-scale commitment to nuclear power.

Criticism

A delay of only 3-5 years is unlikely to result in any significant change in the availability of non-nuclear energy technologies as far as large-scale production is concerned. However it appears possible that demonstration scale plants may be operating successfully within this period in time to allow a reconsideration of national energy goals and the realization of energy savings through ancillary conservation programmes. If the overall demand for energy can be shown to have decreased significantly over this period then the case for adoption of decentralized, smaller-scale plants as an alternative to centralized nuclear power stations will be advanced. Otherwise there will inevitably be a tendency on the part of national governments to attempt to catch up on lost time by accelerating any existing nuclear power programmes.

Position 3. Participation-Reflection Approach

Somewhat different from the moratorium approach is the position that would tend toward depolarizing the nuclear debate, and reduce the rate of proliferation, by introducing a period (2 or 3 years) in which a broad public discussion on nuclear energy development is actively promoted by the governments. This argument is that active participation may postpone decision-taking itself, but will speed up implementation of the ultimately chosen option. The argument is that most of the affected groups would then have had a part in decision-making from an early stage. Essential for this procedure (which will be implemented in the Netherlands) is that it is based on an analysis of alternative energy options in the long-term (up to the year 2000), a social impact analysis of each of these options, to be presented in a clear way in a broad public discussion procedure. This procedure has to be based upon proven participation methods and organized by a government appointed, independent commission. The same approach to decision making on the basis of alternative options and participation of concerned parties should be made to the international sharing of technology, particularly nuclear technology. The participation would involve governments from developing countries, international organizations, etc. The results of INFCE would be invaluable in further discussion.

Criticism

While this approach has a great deal to commend it in terms of the enhanced participation of the average citizen in the decision-making process concerning future energy supplies, there is a sense of unreality about the prospects for radical change at the level of national government. Everything depends on this possibility: whether a clearly stated international agreement can be negotiated. Unless this stimulus is available from the outside, after a relatively short time the popular debate about energy options may be dismissed as simply a "talk shop". It would then only aggressively hinder the deployment of nuclear energy systems to satisfy even the present demand for energy.

Position 4. Some Nuclear Discrimination is Preferable to Further Proliferation

This position assumes that nuclear energy is here to stay, that proliferation of nuclear weapons arising from the further sharing of nuclear technology is a serious threat. It assumes that a certain amount of discrimination is preferable to further proliferation of nuclear weapons. This position is consistent with the position of those who generally support the US Nuclear Non-Proliferation Act of 1978. It aims at tightening the controls on access to sensitive technologies, in particular reprocessing, and to forego reprocessing for the time being, and necessarily requires renegotiation of some cooperation agreements between the US and other countries. This position has achieved some prominence in the Christian community in some industrialized countries (see for example the 1000 names the pledge in support of President Carter, Manchester Guardian, March 1977).

Criticism

In the eyes of many this position, while intending to be politically realistic, is morally and politically untenable because of its self-righteous implications.

Position 5. Full Implementation of the Non-Proliferation Treaty – Access Without Proliferation

This position implies support of the Non-Proliferation Treaty as the only existing international agreement while at the same time seeking to assure the implementation not only of Art. III on control but also Art. IV on international cooperation and access to peaceful nuclear technology. It also includes acceptance of Art. VI on nuclear disarmament. This position says yes to the exchange of nuclear technology and no to the spread of nuclear weapons, on the assumption that the two are separable. This position insists that Art. VI be implemented, thus in the long run removing the inherent discrimination of the Treaty and removing one motive for horizontal proliferation. One must recognize the difficulty in practice of this position in view of the need to finda balance between Art. III, IV and VI.

Criticism

The challenge to this position is to the assumption that nuclear power programmes and weapons proliferation are separable even with full implementation of the NPT. The NPT system, even if strengthened, is inherently too weak

to prevent proliferation. The spread of nuclear weapons facilitated by nuclear power development is almost inevitable. States party to the Treaty tend to put emphasis on the implementation of different Articles but all Articles must be implemented, including Art. VI on disarmament. The solutions to the dilemmas of Art. III, IV and VI are not spelt out. The position neglects the possibility of proliferation by subversive groups. Only the passage of time would lead to confidence in the ability of official international controls seen against the increased risks of all forms of proliferation. It is precisely this period of uncertainty which adds to public anxiety on this and related issues.

Position 6. International Right of Access Without Discrimination

A further position which has emerged during this Consultation puts the emphasis on the right of access to technology, including nuclear technology, the removal of discrimination in existing agreements, and the development of a new international control which would cover all countries. Those who hold this view do not accept that the choice is between proliferation or discrimination, because the abolition of discrimination will in fact eliminate many of the incentives to proliferation. It is maintained that this is a just answer to the problem of international sharing and control of nuclear technology.

Criticism

The challenge to this position sees a potential conflict between national sovereignty and international control. No structures of such international control are spelt out, therefore no judgements can be made as to whether this is possible. The weaknesses of present international monitoring systems which raise questions about whether any effective safeguards are possible at all, are not considered. The denial of the connection between proliferation and the spread of nuclear facilities, even with international control over some parts of the cycle, is unrealistic. Although a few nuclear nations have exercised collective responsibility in relation to the nuclear balance, it does not follow that a large group of nations may be able to sustain the same kind of consensus over the balance of military power. If the latter proves to be the case then giving access to all forms of nuclear technology will destabilize the precarious peace under which the world must live.

4. Recommendation

The present WCC Consultation on "Ecumenical Concerns in Relation to Nuclear Energy" has shown that the WCC can provide a platform on which the views and opinions of different and sometimes contradictory groups can be publicly expressed and discussed. This work towards clearing the lines of communication between different and legitimate desires of the opposing groups is a sensitive role which the WCC might be qualified to fulfill. The working group proposes the following objectives for the future action to be taken by the WCC:

- better and more impartial information;
- further investigation of the six positions presented in this paper;
- sponsorship of careful studies of the human, social, theological, political, economic and scientific-technical questions by independent groups;
- persuading governments of the industrialized countries of the need to generate the conditions to satisfy the demands for a new economic order;
- equal rights of industrialized and developing countries concerning access to nuclear technology;
- collaboration of supplier and receiver countries in industrial implementation programmes and in research and development;
- sharing of economic and political risks and benefits on an equal and responsible basis;
- availability of sufficient energies from the most appropriate sources to the developing world without discrimination;
- limitation of the arms race, reduction of the nuclear weapons stock and no further spread of nuclear arms.

V. ETHICAL ISSUES

Decisions about nuclear energy involve the interaction of technical and ethical considerations. The purpose of this Section is to examine some of the ethical issues that arise throughout the report.

While the churches approach these issues with faith in a God who has determined the purpose of the whole creation, they know that political decisions are made in a pluralistic world including people of many faiths and ideologies. Hence, they must try to address widespread human concerns from the perspective of their faith.

Four ethical issues are the focus of concern:

A. Ethical evaluation of advanced technology.
B. Justice in the international transfer of nuclear technology.
C. Decision-making.
D. An appropriate role for the churches.

A. Ethical Evaluation of Advanced Technology

1. Technology concerns humanity's relation to nature and the role of human beings as made in God's image and for God's creation. However there is no agreement on the theological interpretation of technology.
   - Some Christians look at technology in the light of Gen. 1:28 where humanity is commanded to rule over nature. All kinds of technology are then regarded as instruments to be used to reach this objective. This idea is often combined with an interpretation of human technological activity as a part of God's continuing creation. (Critics have claimed that such ideas have resulted in the lack of responsibility shown in the Western world towards nature.)
   - Other Christians want to begin with human stewardship in the creation. In Gen. 2:15 it is said that God placed humanity in the Garden of Eden to cultivate and preserve it. In this perspective, technology is a tool to be used to conserve rather than destroy the integrity of nature.

   Both these theological interpretations lead to a more or less positive evaluation of technology.
   - But there is another biblical viewpoint which leads to a pessimistic assessment of technology. This is inspired by the story of the Fall coupled with the prophetic expectation of the abolition of all instruments of warfare. All technology which can be used to destroy humanity is, in this perspective, evil. Nuclear technology, or some aspects of it, is assessed in this way by many Christians.

   It was not possible in the Consultation to reach a common understanding on the correct use of these different theological perspectives.

2. All Christians agree that it is Important to apply the Commandment to love one's neighbour in relation to the use of technology. Since the use of technology has an effect upon the welfare of individuals and societies, the command to love one's neighbour as oneself implies a principle of distributive justice. Technology often is not used to increase human welfare but to promote the interests of particular groups, making the rich richer and the poor poorer. It can also be used as an idolatrous instrument by a humanity which tries to take the place of the creator God. A crucial point in the nuclear debate is whether nuclear power promotes justice and the welfare of our neighbours or hinders them. (The papers from this Consultation are in fact attempts to reach a responsible decision on this issue.)
3. There are conflicting views on the social issues raised by the increasing use of advanced technologies like nuclear energy. Such capital-intensive technologies frequently result in concentration of economic and political power and centralized decision-making. They then jeopardize desirable social aims, including fuller participation in decision-making.

   But all energy technologies, whether nuclear fission, coal synthesization and combustion, solar, wave power, geothermal, fusion, pose ethical issues. And it is ethically important to keep open a range of technical options as long as possible, which means funding research and development to the fullest possible degree.

   The following ethical questions need to be asked of every energy technology in considering its national, regional and international implications:

   - What is it intended for?
   - What damage or risk does it impose upon people and nature, particularly in comparison with alternatives?
   - How does it promote or threaten human freedom and community?
   - Can it be so used that its benefits will be distributed equitably?
   - Will it benefit some and harm others, or will only those who benefit bear the financial, social, physical and environmental costs?
   - Does it require great concentrations of political and economic power, and if so, how can that power be held accountable?
   - Does it enable people to participate responsibly in the decisions that affect their own welfare?
   - In what ways does it benefit or harm future generations?
   - In what way does the mentality associated with the use of the technology affect the self-understanding and world views of people?
   - In what ways does the use of the technology affect human rights and religious and ethical convictions?

B. Justice in the International Transfer of Nuclear Technology

The issue of proliferation of nuclear weapons with their threats to the world presents a stark moral dilemma in the present historical situation.

It seems obvious that nuclear weapons should be limited in every possible way. This means, in practice, advocating nuclear disarmament or – as a minimal first step – a halt to the increase of stocks by the nuclear powers (vertical proliferation) and measures to prevent the spread of nuclear weapons among other nations (horizontal proliferation). The Nuclear Proliferation Treaty has this objective and has had some success in hindering horizontal proliferation. Therefore the Treaty, with all its imperfections, deserves support as a means of limiting the threat of nuclear war.

At the same time the NPT perpetuates an intolerable discrimination between privileged and non-privileged nations. The real threat comes from the nations with nuclear arsenals on which depend their power and security. The effort to stop horizontal non-proliferation will have no credibility unless and until the nuclear-armed nations begin to disarm or stop adding to their stocks.

Another aspect of the dilemma is apparent in the debate about nuclear energy and possible risks of proliferating nuclear weapons associated with it. Through the safeguard systems and inspections of the IAEA (implemented through the NPT) this risk is diminished. However, the present resources of the IAEA are inadequate to this vital assignment and must be strengthened. As a result, individual nations (e.g. USA) in the developed world have considered it to be in the interest of world security to impose their own limitations on access to and use of nuclear fuel. There is here a conflict between the desire for security and the need for confidence between nations. Many non-nuclear industrialized and developing nations are critical of the conditions imposed on them by the nuclear nations for the sharing of nuclear technology. They regard it as a new form of paternalism, and a sign of the unwillingness of the powerful to share their power.

Some possibilities exist to mitigate this conflict between security and confidence:

- to the extent that vertical proliferation is stopped, the case for horizontal non-proliferation begins to gain credibility;
- to the extent that powerful nations accept the international controls and restraints on sensitive technologies that they now impose on other nations, their credibility rises;
- steps toward a just and participatory society, including a new international economic order, may decrease the desire of many societies to acquire nuclear weapons;
- every act that builds trust among nations reduces the incentive to obtain armaments;
- many of the large uranium deposits are located in the developed world (i.e. USA, Canada, Australia, South Africa, Sweden and the USSR). The willingness to establish some kind of international control over these resources could be important in the present context. The possibilities of some kind of international regulation of the uranium market could be of importance to the security of nations seeking access to nuclear energy.

C. Decision-Making

To a large extent decision-making in key areas of nuclear technology will always depend on the present state of knowledge as reflected in our understanding of the effects of high and low level radiation, particularly where these impinge on systems of food production, the gene pool and other natural systems. In the first instance a great deal of research has already been carried out on the effects of intensive radiation damage on chemical and biological systems. Substantial correlations relating radiation dose to specific damage have been widely reported in scientific literature. However much greater attention will now be given to understanding the threshold effects of comparatively small doses of ionizing radiation, as it is still largely unknown whether the systems can adapt to the damage effects incurred at these low levels. However this uncertainty relating to low level effects of

radiation is similar to the uncertainty which exists, for example, with minor chemical pollutants which are released to the environment at "tolerable" levels. An educated public response to these assessments will take some time to emerge and it would be unfortunate if a rush to judgement on either count seemed to prejudice the outcome of the established methods of scientific enquiry.

D. An Appropriate Role for the Churches

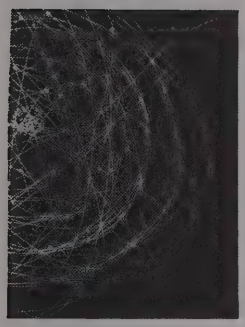
The ethical implications, social costs and environmental consequences of energy policy are frequently overlooked in decision-making and are at least as important as technical and economic factors. Churches can act to ensure the widest possible participation in decision-making and help avoid the tendency to reach quick decisions on vital energy policies. The churches could also play a vital role by initiating discussions on these issues among their concerned members, technical experts of differing opinions and competence on various alternatives, and the general public. Such discussions should go beyond the nuclear issue to the nature of a materialistic, industrialized and technological society, and to an exploration of the kinds of life styles and social and economic systems which might be more in accord with the demands of the Gospel.

Beyond this important task, the Church by its nature has a particular responsibility to facilitate open and concerned communication among persons of all opinions. Each Christian has a responsibility to look to the position of all other persons for signs of their concern for justice, for participation in societal decisions, and for the sustainability of the creation.

However the differences are often not over these goals, but over how they may be attained. We are all human beings struggling with the same questions: we shall, with all integrity, arrive at different conclusions, and we have a responsibility to defend our own convictions.

Participants in church consultations on energy have not always experienced this Christian ideal. Anti-nuclear Christians have frequently felt belittled by those holding other views and shut out from the official power structure of their churches. Pro-nuclear Christians have been subjected to moral condemnation as self-seeking and insensitive or uncaring about the just aspirations of others. There has been a lack of openness to hear and to try to comprehend the different ways in which people perceive the issue of nuclear energy – for instance, as a technical issue, as a symptom of the ills of industrialized society, as a symbol of human ability to overcome the finite supply of resources, or as a temptation to avoid facing radical societal restructuring to ensure justice for all God's children. We at this Consultation have sometimes had the experience of first classifying others as opponents and then discovering them as persons.

If there is any reality to the Church as the Body of Christ, it should surely be possible through the grace of God for Christians to show mutual pastoral concern and tolerance for opinions different from their own, and for them to accept the ambiguity and uncertainty of many ethical judgements about such complex matters as nuclear energy.



STATEMENTS AND REACTIONS BY SOME MEMBERS OF THE CONSULTATION

Statement Signed by a Number of the Participants in the WCC Consultation on Nuclear Energy, May 2-7, 1978

It is the sense of the undersigned participants of this consultation that:

a) The control of civil uses of atomic energy is inseparable from the issue of disarmament. The consequences of nuclear war are irreparable, the consequences of other setbacks in world politics can be corrected. The actions of the superpowers that contribute to the nuclear arms race are an insult to human dignity and intelligence – the triumph of craziness. The production and eventual abolition of nuclear weapons *must have absolute priority,* even at the risk of lessening the national or personal security of those who have control over these weapons of mass destruction and annihilation.

b) The world is drifting toward a future plutonium economy. Given the grave risks posed by this prospect we believe there is a need for time for reflection. We, thus, recommend that further development of nuclear fuel reprocessing, the use of plutonium as an energy source and further construction and demonstration of commercial plutonium-based reactors should be postponed indefinitely.

Signed by:

Ola Johansson; Chris Cowap; Lysanes Maciel; Siegfried Christiansen; Leo Keller; Jan-Luc Blondel; Gerd Aarset; Eric-Jan Tuininga; Herman Johannes; Helmut Milcke; Thomas B. Cochran; Volker Schmidt; Carl-Reinhold Brakenhjälm; Keith Roby; Sean Goddridge; André Bieler; Ulrich Ratsch; Prince Sadruddin Aga Khan; Michel de Perrot.

Reaction to the Report from a Group of Participants

We shall not comment on individual passages in the report which is a fair and adequate reflection of the discussion which took place at the Consultation. We do, however, wish to state emphatically that, because of the planning of the Consultation, and the assumption underlying it, certain

crucial theological aspects of the argument surrounding nuclear energy, of considerable importance to the churches, were prevented from surfacing. Having been involved in the nuclear energy debate for some considerable time now, the organizers may, naturally enough, have felt compelled to attempt to reach a consensus at this stage since the whole discussion appears to have reached stagnation point, with opinions divided between two diametrically opposed positions. Their attempt is perhaps especially understandable under the pressure of the forthcoming conference in Boston. Nevertheless, we regard the assumption that a consensus on the issue of nuclear energy is possible at all at the present juncture as false, and even politically and theologically dangerous.

1. It is not adequate, in our opinion, to interpret the division of opinion for or against nuclear energy as a disagreement over apparently technical questions (the size of energy needs, the safety factor, the ecological question, etc.). It would be more to the point if the churches, in their discussion of the issue, recognized that, to an increasing extent, the differences of opinion on nuclear energy are related to two conflicting cultural conceptions, two conflicting visions of how to provide security for the future. One side assumes that the limits to growth can be ignored, at least for the time being, while the other has the feeling that those limits have already been reached, not to say exceeded. We call this argument a *cultural* controversy because the different assumptions made by the two sides are bound up with different designs for living and, more and more often now, with different life styles in practice. It was admitted at the Consultation that should a radical change in life style take place "some day", this would decisively alter the terms of the energy debate. We are of the opinion that, in discussing this issue, the churches must face the fact that such change of heart has already taken place in many places and that the first steps towards a new way of life are already apparent. The churches also have to realize that, at present, the two conflicting cultural conceptions are irreconcilable, even though many people on both sides consider themselves as Christians, have reflected theologically on their own position and are prepared to answer for it.

2. As things stand, it is dangerous for the Church to commit itself in the attempt to formulate the consensus apparently held to be possible by some people, because, in doing so, it contributes to heightening the sense of helplessness experienced by the people who are making a serious effort to live their own lives in a way which respects the limits to growth. Apart from anything else, a consensus would only be viable in the long run if it gained acceptance by wide sections of the public. There are no signs of such a consensus developing in the public debate at present, and to try to establish a consensus in the churches is to disguise this fact. The attempt seems to us all the more premature in view of the fact that there has been no adequate discussion of the fundamental discrepancy between the two cultural viewpoints, in the church context or anywhere else.

3. A further consideration is that the conflict between the two conceptions, or rather the cultural visions of how to safeguard the future, has reached a particularly dynamic stage at present. More and more sections of the population in the industrialized nations are becoming involved in the intensive discussion of the problems. Attitudes influenced by the idea that there are limits to growth are gaining ground, even if conventional ideas of how to provide for the future continue to dominate. The outcome of this dynamic development is not yet in sight and it is hard to say whether, in the end, one cultural concept will prevail over the other, or whether there will be a balance, with different cultures coexisting with one another.

In fact, the question dealt with at the Consultation should really have been, "Can the use of nuclear energy be justified?" However, since the advocates of nuclear power were both numerically and organizationally in the stronger position, their assumptions controlled the course of the debate and, consequently, the tenor of the report, which is that nuclear energy is the only possible way of bridging the impending energy gap. Hence it has been established that nuclear energy must be justified. Because, unless we cover the expected gap, we can expect to face a situation of acute crisis and injustice. It is then consistent with this reasoning not only to assume a considerable rise in the level of energy consumption in the developing countries, but even to admit a "necessary" increase in consumption in the industrialized nations.

If one sets out from the assumptions of the minority, however, the real issue before the conference (Can nuclear energy be justified?) has to be discussed in radically different terms. Our thinking is based on the assumption that there are limits to growth, and the most important are *not* necessarily in the field of resources:

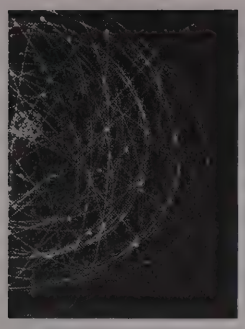
- There is, however, an ecological limit to the environment's capacity to absorb heat.
- There is a limit to the centralization of social services and infrastructures. It is becoming increasingly obvious that mammoth institutions and massive concentrations of industrial processes do more to destroy the quality of life than improve it.
- There is a limit to how far technological domination of nature can be developed. We question the assumption that human interference with nature has only limited local repercussions which can be controlled by appropriate local counter-measures. There is more and more evidence to show that the harmful effects of large-scale technology on nature are cumulative and that the efforts to dominate nature – instead of living in harmony with it – are progressively destructive.
- There is a limit, lastly, to the capacity of the human constitution to go on furnishing the additional energy needed to wring more and more benefits out of nature.

If one's thinking is based on a conception which regards the limits to growth as already reached, the questions are reversed. The question then becomes, not how much energy we need, but what level of energy consumption nature can sustain – globally – and what kind of life style is compatible with the limits to growth. With this perspective, the whole question of what "demand" and what "needs" are in fact real is open to rediscussion. There has to be a distinction between the needs of the Third World and those of the industrial nations. For the industrial nations at least, the groups which are against the use of nuclear energy are trying to instigate a policy which will halt any further growth in the consumption of primary energy as soon as possible and lower it in the medium term. Here is should be taken into account that in connection with the various people's initiatives there has been growing discussion and acceptance of this position and that, if the appropriate conditions are created, it is viable.

Signed by:

Gerd Anne Aarset, Oslo
Siegfried Christiansen, Copenhagen
Leo Keller, Zürich
Helmut Milcke, Stuttgart
Ulrich Ratsch, Heidelberg
Volker Schmidt, Hamburg

as participants in the Consultation



A STATEMENT BY THE WORKING COMMITTEE OF CHURCH AND SOCIETY

The following report from the sub-unit on Church and Society to the Central Committee of the World Council of Churches includes a Preamble and two parts:

Part One: A short summary statement of our present position.

Part Two: A longer statement of our present position.

Preamble

The sub-unit on Church and Society reports to the Central Committee of the WCC that it has carried out the instructions received from the Central Committee (August 1977) to convene a Consultation on Ecumenical Concerns in Relation to Nuclear Energy. The consultation took place at the Ecumenical Institute, Bossey, in May 1978. Its findings are transmitted to the Central Committee herewith. The findings, along with the papers prepared for the consultation, will be published in *Anticipation* in early 1979, where they will be available to the Central Committee, to member churches and interested people.

The Bossey Consultation, in accordance with instructions from the Central Committee, included 60 persons from a wide variety of geographical areas, social systems, expert skills, and attitudes towards nuclear energy. This great diversity made for a rich discussion; it also produced disagreement on many controversial questions, thus reflecting faithfully the situation in the churches. Nevertheless it reached strong agreements on some ethical issues.

The sub-unit on Church and Society, on the basis of a sequence of work (the Bucharest Conference, 1974; the Sigtuna Hearing, 1975; several subsequent meetings of the sub-unit and its Energy Advisory Committee; the Bossey Consultation, 1978) now makes the following report to the Central Committee as its effort to state the ecumenical situation at this stage of discussion.

Part One

In briefest summary, we find:

1. The nuclear debate cannot be addressed, in an absolutist sense, without consideration of other energy options, including especially energy conservation and the possibility of technologically less complicated societies. In this respect, the issue is for many governments and peoples not as clear-cut ethically, as is for example that of racism. Failure to recognize this complexity has contributed significantly to the present dishevelled state of the debate.

2. More specifically, energy consumption and more rational use of energy deserve much more attention than they generally receive, especially in the industrialized countries. This matter is germane to the nuclear debate because reduced (or less rapidly growing) energy demands change both the desirability and availability of the various energy supply options, including nuclear power, its chief present alternative (coal), and its chief future alternative (solar).

3. Most of the nuclear debate is but symptomatic of a much deeper societal debate about more technology or less, about centralized versus decentralized, appropriate (versus inappropriate?) with many groups defining these terms to suit their own social aims. At this time there is no ecumenical position on this much broader debate which will be one of the major issues before the World Conference of 1979.

4. No grounds exist for *rejecting* nuclear power categorically. On the other hand, it cannot be *accepted* categorically; it is a conditional good, subject to reasoned acceptance under some circumstances and subject to reasoned rejection in others. Even where accepted there may be a point when we may have to say, "Thus far and no further". The particular circumstances relate to need for energy, availability of alternative sources, the likelihood of increasing or decreasing the danger of proliferating nuclear weapons, and whether nuclear power in any particular case contributes to a more just, participatory and sustainable society, or to its opposite. Certainly the scale of possible dangers and benefits exceeds that which society is accustomed to consider, and choices to proceed with or renounce civilian nuclear power should be made in each case only after profound deliberation.

Part Two

1. The Basis of the Concern of the Churches

The Christian churches have an authentic and inescapable concern with the world-wide energy problem. Energy is essential to human life. Its modes of production and consumption, which influence the conditions of life and social relations, require ethical decisions. Many seemingly technical debates rest on ethical assumptions, implicit or explicit, and have ethical consequences. They even provoke questions about the very meaning of human life.

There is today a rising demand for energy in the world. In part the churches must endorse this demand: it represents relief from poverty and freedom from external economic domination. In part the churches must criticize this demand, insofar as it represents extravagance and the notion that rising consumption always means a higher quality of life. In any case, the rising demand meets dwindling supplies of traditional forms of energy: firewood, coal, natural gas and petroleum.

The combination of increasing demand and increasing scarcity means that major social and economic changes must come. These changes have significance for the efforts of the churches to contribute to a just, participatory and sustainable society.

In addition to its immediate practical importance, energy, especially nuclear energy, has acquired a powerful symbolic meaning. To many people and movements, it is the most impressive symbol of the advanced technology that has so greatly influenced modern life. It represents that technology in all its promise and its peril. It represents the human ability to use and transform nature and society. It

represents the capacity to build and destroy civilization. Advanced technologies, which may be either servants of humanity or idols demanding subservience, present theological and practical questions about the purpose of human existence. It is not surprising that the debates about nuclear energy raise high passions within the church and the world.

2. Diversity of Opinions within the Churches

On some issues, the churches feel a strong call to unite in an ethical witness. Racism, for example, is such an issue. The World Council of Churches sees opposition to it as a test of authenticity of faith. It believes that, even if its stand may sometimes be divisive, its commitment contributes to a deeper unity of shared witness.

On other issues the churches recognize strong differences of opinion and seek to maintain a continuing dialogue among their own members. These differences are not limited to trivial matters. For example, the World Council of Churches includes pacifist member churches, and other churches that include pacifist individuals; it also includes revolutionaries. Both groups contribute insights to the WCC. They continue to try to influence each other. And the WCC includes both within its fellowship.

Nuclear energy is one of those issues on which the churches find great differences of opinion among their members. They include, for example, nuclear scientists and engineers who see their work as a way of serving humanity. Church members include also individuals and organized groups who oppose nuclear energy, sometimes trying physically to prevent the construction of power plants.

Some of these differences of opinion among church members arise because of different estimates about questions on which nobody can have certainty. For example, (1) the relative dangers of coal and of nuclear energy to producers, to consumers, to the environment; (2) expectations of technical progress in research and development of solar energy, bio-conversion, fusion, etc.; (3) different perceptions of the relation between peaceful production of energy and the proliferation of nuclear weapons.

On some of these questions new information may lead to greater clarity and agreement. But for the time being it is important not to foreclose discussion by silencing the variety of opinions. The churches, although they have an interest in such questions, do not have any unique authority to answer them.

Differences between churches arise for example because of:

- Different resources. For example, some societies have petroleum, natural gas and coal; others do not.
- Differing experiences and needs. For example, some churches see their own societies as overconsumers that should reduce energy consumption; others see their societies as underconsumers that need more energy.

The issue of nuclear proliferation illustrates vividly (some might say tragically) the ethical and political dilemmas facing humanity with regard to the use of nuclear energy. Many oppose nuclear energy because it cannot be completely separated from the development of nuclear weapons. But this problem must be faced in the present context of some nations already having nuclear weapons and others claiming the right of access to nuclear technology, even if it means the risk of further proliferation. Where there is no realistic political hope for nuclear disarmament by the major nuclear powers, what is the ethical justification for asking non-nuclear nations to give up their right of access? And if there is no hope of stopping the spread of nuclear technology, what political means (international, regional and national) will best insure some kind of effective international control of nuclear proliferation? The Bossey Consultation points to six mutually exclusive positions on this issue held by different groups at the meeting. We urge the churches to make their own further study and examination of these six positions, all of which have some claim on the Christian conscience.

Other questions raised by the energy debate come closer to the traditional concerns of the churches. For example, behind many an argument is the deeper issue of what kind of human society is really good. What of modern technology contributes to liberation of people from poverty and want, and what imperils the most basic human values? To what extent does the answer to that question lie in technologies and to what extent in the social and cultural systems that employ the technologies? Continued discussion of such questions may lead to greater agreement within and between churches, but such agreement will not be instantaneous.

In facing these questions, we realize once again that the churches are not repositories of answers to all human questions. We should expect that Christians, though faithful to the light that is given them, will share in many of the perplexities that belong to human life and that they will keep searching and struggling for answers.

3. Some Affirmations

Despite some differences and uncertainties, we find ourselves agreed on several important affirmations. We state these in relation to our efforts towards a just, participatory and sustainable society.

Justice requires criticism of the vast inequalities in access to energy, both within most societies and between the rich and poor societies of the world. The sharing of resources and technologies is a moral demand. Too often resources are imported by nations which, because they are already rich in resources, can afford to pay for them, rather than by nations with greater need. Justice requires sharing also of risks. In any energy system, it is unjust to maximize cheap energy by imposing exorbitant risks on an exploited group.

Justice requires also attention to the social and economic context within which energy systems work. For example, the reduction of energy consumption in a wealthy society, even when desirable for the sake of international justice, can inflict the injustice of unemployment on workers, wherever economic systems require increasing consumption in order to maintain enough jobs. But the same reduction of energy consumption might be planned to increase employment by some shift from capital-intensive to labour-intensive production. It is the social management of energy, rather than energy in isolation, that determines the issues of justice.

Participation requires new attention to the way in which people share in the decisions that affect their lives and welfare. We mention two examples. The first can occur in any society. Wise decisions require the best scientific, technological information and judgement. Yet society must not abdicate moral authority to any expert élite. That is why the Central Committee of the WCC in August, 1976 called for "full public consultation on the social and ethical implications of long-term energy choices".

The second example is the international transfer of technologies. It is sometimes argued whether the introduction of new technologies perpetuates patterns of dependence or offers opportunities for liberation from such patterns. While it is true that technologies themselves can influence such patterns, it is more important to recognize that financial and organizational arrangements surrounding those technologies have much to do with their impact. The critical issue is that such transfers be organized so as to increase rather than destroy the abilities of people to share

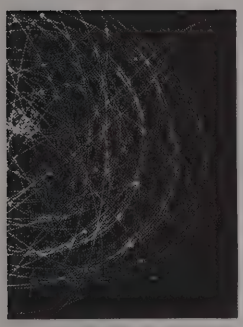
in the making of social decisions and so as to hold centres of power responsible to the people.

The importance of *sustainability* reinforces the demand for justice. So long as there were illusions about unlimited cheap energy, the privileged could pretend that they did not need to share their wealth, because others could acquire wealth by imitating them. The end of that illusion makes major steps towards justice more urgent. To sustain human life on this planet now clearly requires conservation of non-renewable forms of energy, certainly in this period of transition from dwindling energy sources to new sources, and probably for all foreseeable futures. The waste of energy in all societies, if it once seemed harmless, is now a clear moral wrong. The absurd extravagance in some societies, always morally offensive, is more clearly than ever the exploitation of the poor by the powerful rich. Among the forms of waste, militarism is one conspicuous diversion of resources from human needs.

Sustainability also requires foresight and planning. Societies invite catastrophe if they wait for emergencies, then rush to adopt new technologies that require lead times of 20 to 50 years. Perhaps the most morally demanding foresight is that involved in concern for future generations, whom we can heedlessly imperil by exhaustion of resources that they will need, or by careless disposal of wastes, whether these be the carbon dioxide and sulphur dioxide that result from burning of fossil fuels or radioactive wastes from nuclear energy production.

In making these affirmations we encourage the continuing attention of the WCC and its member churches to the ethical and theological issues connected with energy. We note that such issues will get further attention at the 1979 Conference at MIT. We do not urge further programmes to repeat the past debates of Sigtuna and Bossey. But we recommend that the churches and the sub-unit on Church and Society continue to watch new developments and look for their ethical implications. Churches can urge their members, in many societies and many walks of life, to become sensitive to the ethical issues often forgotten in routine discussions of technology and productivity. For example, in some countries there is an urgent need to press for more effective public involvement in decisions about the regulation and use of nuclear power. Wherever the churches are, individuals and societies are making decisions about energy that bear upon the meaning of human life and moral responsibility.

In particular, we recommend that the churches and the WCC continue to work on questions often left outside the purview of discussions centering on energy. What do we mean by a high quality of life? How is such a life related to production, distribution and consumption of energy? What sort of life do we really want for individuals and human communities, and how does that life relate to natural resources and human ingenuity? How does Christian confidence in the Kingdom of God influence Christians' visions of better lives and social orders for themselves, their neighbours and generations to come? Such questions call for Christian efforts to understand and act on the meaning of the Gospel for our day.



FAITH, SCIENCE, IDEOLOGY AND THE NUCLEAR DECISION

*Roger Shinn**

My title brings together three words that have to do with ways of knowing and judging: faith, ideology and science. My aim is to show how each of these enters into decisions about important human problems.

Let us begin with a common saying, attributed to many people, perhaps most often to Karl Barth. The Christian, as the saying goes, meets the world with the Bible in one hand, the daily newspaper in the other. Each hand represents something essential. Christians live by a faith, a loyalty, a commitment coming out of a heritage. They live with an alertness to what is happening in the world right now. Policy decisions take place at the intersection of faith and the contemporary world. Neither the faith nor the news alone is enough for responsible decisions.

Biblical faith tells me to love my neighbor, even my enemies. It does not tell me the facts about world hunger today, about exhaustion of firewood in some areas, about the effects of rising energy costs on poor people and nations. The newspaper gives me information about my neighbors and enemies, including many I have never seen. It sometimes tells me that I and my society are helping or hurting people we never see and seldom think about. To think and act intelligently, I need information about my world, about God's world.

But that information will not by itself produce an ethical decision. Reading about shortages of food and energy (and realizing that the two are closely related), I may decide to grasp more tightly my resources so that I do not suffer from the shortages. Or I may decide to share my resources with other people in need. I may throw my efforts into increasing the resources. Churches, social classes and nations make comparable decisions. The decisions will never depend upon information alone. They will depend on ethical sensitivities, on commitments, on some sense of what life is about and what our human destiny is. To be human is to live with ethical concerns that call for decisions. Churches and Christians, insofar as they are Christian, draw those concerns from the biblical story of the God who has met us in Christ, from the biblical account of creation, providence, forgiveness, liberation and hope.

That is why it can be said that Christians act with the Bible in one hand and the newspaper in the other. That saying, of course, symbolizes far more than it says literally. To get at its meaning requires another step in the understanding of ethical decisions.

---

* Roger Shinn is Professor of Social Ethics, Union Theological Seminary, New York City.

Faith and Science

Today, more than ever before, the information that enters into major policy decisions is often related to science and scientific technologies. Responsible decisions require information more precise and complex than most newspapers report. Decisions require the best scientific data, conceptualizations and estimates. Without scientific technology there would be no decisions about nuclear energy. There would be no petroleum industries, solar energy industries, electrical grids covering many societies.

Many of the most passionate debates about nuclear energy center on conflicting scientific reports and projections of opportunities and dangers. The scientific reports are sometimes bewildering in their complexity and their disagreements. It can be annoying, even infuriating to realize that we lay people, trying as responsible citizens to make decisions, are so dependent on the expert knowledge that comes from the sciences. Yet the scientists are not much better off. So specialized has science become that its best practitioners, as soon as they venture outside their range of competence, must depend on other experts. Even more must the political leader or the citizen – evaluating the merits and dangers of coal, conventional nuclear fission, fast breeder reactors, solar enegy and projected fusion devices – draw upon the best available information from science. Ethical decisions about energy, if they are scientifically uninformed, are likely to be foolish and irresponsible.

This does not mean, of course, that citizens simply look to scientists for oracular announcements. The rest of us can interrogate them, ask them why they sometimes disagree among themselves, require them to answer our questions and explain their ideas. That is why it is important for churches, when they enter into decisions about energy, to draw scientists into the discussions. Sometimes we may find that in their enthusiasm for their projects they have neglected to ask questions that are important to society. Just as often we may find that their moral sensitivity has led them to ask questions that the broader society has not yet asked.

Science, though certainly not infallible, has won an impressive authority in understanding the processes of nature and the possibilities of technology. Societies and churches, when they make policy decisions, need to rely upon that authority. Yet it is just as important to say that scientific authority is not identical with moral authority. Scientific information and understanding will influence our moral choices. It will expand some possibilities and refute others. But every human being and every community must still decide what moral responsibility requires.

Take a current example. People and societies want to know how much petroleum is left in the ground. How much of it is recoverable by present techniques or innovative techniques? What are the costs of recovery? At what point does the extraction of petroleum consume more energy than it gains? These questions are scientific and technical. They are controversial – and one recurrent human perplexity is that fateful policy decisions often depend upon uncertain knowledge and estimates. Answers will not come from Isaiah or St. Paul, from Jesus, from the Council of Nicea, from Vatican II or from an Assembly of the World Council of Churches. Answers, however adequate or inadequate, will come from the scientific-technological enterprise.

But there is another set of questions about the same subject. What are my rights to that petroleum compared with the rights of other people? I can buy more petroleum than most of the people of India. My nation can buy far more than the nation of India. Is it right that we buy and consume so much? What is the meaning of our patterns of consumption, of our exercise of power, of our definition of personal and national security? It is not the physical scientists and technologists who will answer these questions – save insofar as they are human beings as well as experts. Some help will come from other sciences – from economics and political science. But the questions quickly drive us to the most basic issues of ethics and of faith.

It helps to sort out the two kinds of questions. There are different ways to think them through.

For example, on scientific questions we do not usually expect answers from the Bible or the theological tradition. On moral questions our ethics and values will always be grounded in some kind of faith.

Where can we hope that the churches will give leadership? Most obviously on questions of faith and ethics, not of scientific information. But the churches must engage the world of science and technology or they will never get to the point of hard, concrete decisions. That engagement is the point of a process like this.

Let me summarize the argument thus far. I have been trying to distinguish between science and faith. I appreciate both. I believe that both are gifts of God. But they use different methods. Thought and action must distinguish between the two. Faith does not tell me what the reserves of petroleum are; science does not tell me what I ought to do about grabbing or sharing resources. If churches fail to distinguish between the two activities, they find themselves in a mess. The churches have a long record of making scientific judgments that they should not have made *and* of abdicating from moral judgments that they should make.

But we cannot entirely separate the two kinds of judgment. And that brings me to the third word in my title.

The Prism of Ideology

The word ideology has many meanings. In one meaning, derived from Marx and elaborated by Karl Mannheim and others, it is the distortion of reality due to the surreptitious efforts of a person or social group to protect a privileged position. I suppose we all oppose that. In another common meaning it is simply a fighting creed. I suppose we might favor or oppose that.

Today I want to use the term in another common meaning. An ideology is *a set of conceptions or a picture of the world and society that helps to guide action.*

In this sense of the term, every person and every group has an ideology. Ideology is necessary for functioning in the world. It helps us set up our expectations and to choose ways of acting to attain ends.

An ideology is neither faith nor science, although it can include elements of both. It includes a lot else, from experience and common sense. It is an amalgam of information, ideas, purposes, emotional tones.

It includes, for example, some economic ideas about the relation of work to production, about inflation, unemployment, industrialization, money, taxation and commerce. It includes political ideas on the role of government, participation of people, human rights, the kinds of power that accomplish different aims, the relation of utopianism to realism. It includes ideas about the role of coercion and violence in society and history.

Usually it includes some slogans: "the greatest good of the greatest number", "majority rule", "class warfare", "classless society", "laissez-faire", "from each according to ability, to each according to need", "small is beautiful", "economies of scale", "perpetual revolution", "liberty, equality and fraternity", "government of the people, by the people and for the people", "one person, one vote", "self-determination", "racial equality", "sexual equality".

All people and groups have ideologies, in the sense of my definition. One might almost say: The more they ignore or deny ideology, the more powerful it is. They cannot question or doubt the ideology they do not recognize.

An ideology includes information. But it is not primarily a collection of information. It is the framework into which we fit information. It determines what information, among infinite possibilities, is important enough to grab our attention. For that reason an ideology helps us to see some things – the things that are important to us. It also filters out some other things – the things that might distract us from important concerns or the things that might interfere with our aims.

That is why, when people (even within the World Council of Churches [WCC]) look at the world, some see the population problem. Some see social inequalities. Some see triumphal technologies that will overcome our problems. Some see exhaustion of resources. Some see several of these, but always with some accents and priorities.

I said earlier that policy decisions take place at the intersection of faith and the contemporary world. Now I must say that this intersection takes place within an ideological context. The reason is that there is nowhere else that it can take place. I do not mean that ideology always reigns unchallenged. There are possibilities for bringing ideology under the criticism of both science and faith. But that is not easy.

First, science. Any responsible thinker will intend to correct erroneous opinions with accurate scientific knowledge. But nobody can know and take account of everything. There is too much in the world. There is too much even in any single room at any moment for anyone to take full account of. The important thing is to concentrate on the relevant. But our ideology largely determines what we consider relevant. It is hard to correct ideology by science when ideology determines the direction of our scientific attention.

Second, faith. Any Christian recognizes a responsibility to bring ideology under the judgment of faith. But that is hard to do when faith is already infused with ideology. As an example, think of the recent WCC studies on violence. They ended with some fundamental disagreements, because the participants understood their faith within differing ideological contexts. They ended in some agreement because of a share faith that, in some ways, transcended ideological differences.

Any process of inquiry on a topic like nuclear energy will gain in clarity and honesty if we do our best to distinguish judgments based in faith, in scientific understanding and in ideology. Then there will be another gain in clarity and honesty if we realize that we cannot entirely distinguish those three kinds of judgment.

The Measurement of Risk

Faith, science and ideology, I have been saying, converge on most policy decisions. A good example is the issue of risk. All discussions of nuclear energy sooner or later come to the question of risk. The reason is obvious: Nuclear energy offers definable advantages – at a risk.

I have heard it said occasionally that the church needs a theology of risk. No ecclesiastical council has ever formally defined a doctrine of risk, and I neither expect nor advocate such a definition. Yet the Christian tradition is rich in testimonies about risk.

A year or two ago in one meeting of a committee of the WCC, a discussion on nuclear energy was centering on the questions of risk. We were all concerned to minimize risk. As the talk rose in ardor, my eye – coincidentally or providentially – fell on a book that we had used in morning worship. The name of it was *Risk*. It was a regular publication of the WCC in the special edition prepared for the Nairobi Assembly. It reminded us that risk is – in Christian rhetoric if not so often in practice – a "good" word. Think of Moses leading a fearful people who longed for the security of slavery rather than the perils of freedom. Think of the prophets. Think of Jesus, deciding to go to Jerusalem. Think of the church of the martyrs.

But some risks are immoral. To jeopardize people and values for the sake of domination and greed is sin. To put others at risk, without their consent, for our own benefit is sinful. Even the risks taken by careless automobile drivers who do not love their neighbors or themselves enough to practice self-restraint are sinful.

The risks of nuclear energy are perplexing because there is little experiential base for reckoning just how grave they are. Risk assessment has become a sophisticated enterprise. And it is controversial.

Advocates of nuclear energy frequently argue that in the US, with a history of about a thousand reactor-years of comercial operation, there has not been a single death *directly* traceable to nuclear accidents. There have been some major accidents to property, but none fatal. There have been accidental deaths not directly attributable to the nuclear process – none of them, to my knowledge, so immense as the death of 51 construction workers building a coal-fired generator in the US on April 27, 1978.

If we extend the field of inquiry, it appears that there have been no deaths *directly* traceable to nuclear accidents in any society that has a free press which can report such events. By comparison, we are in the habit of expecting 100-150 deaths per year from accidents in coal-mining in the US – plus the uncounted deaths from black-lung disease. One study concludes that a single one-thousand-megawatt coal-burning generator accounts for 11 deaths a year (mining accidents, black-lung and transportation) – without even counting the deaths and genetic mutations that come from the combustion wastes spewed into the air.

Any conclusion must still be tentative. A major nuclear accident might today change the data-base radically. We are comparing measurable evidence about coal with still unmeasurable evidence about nuclear energy. Neither faith nor science gives us certainty – and ideology by its nature cannot give certainty, although it often gives its holders the psychic feeling of certainty.

Another risk centers on the hazards of plutonium. Some call it the most toxic substance in existence. Peter Dyne says that radium is 15 times as noxious per gram as plutonium. Some say that polonium, commonly present in tobacco, is as hazardous as plutonium. I don't know. I want to know. I don't expect to find out from biblical tradition or from ideology. I want to find out from scientific evidence. The nature of the present debates shows how difficult it is to separate scientific evidence from values and ideological preferences.

Still another risk lies in the relation between nuclear energy and nuclear weapons. Just what is the linkage? We can start with the obvious fact: The great nuclear arsenals of the world are not by-products of the peaceful production of energy, nor were they built by clandestine diversion of materials from peaceful reactors. Granted that, it may still be true that weapons will be somewhat easier to make in a world where nuclear generators are commonplace. Perhaps processes can be developed whereby weapons-grade materials cannot be secretly diverted from energy-production, even in breeder-reactors and their complete fuel cycle. The argument on that issue is scientific, not theological or ideological. But ideology is obvious in the usual pattern where countries

with nuclear arsenals have a high moral sensitivity to the possibility that non-nuclear countries might get weapons.

Deciding for Posterity

A last risk is nuclear wastes. *If* the truth is that present nuclear operations are creating enormous dangers to people for thousands of years to come, that is a moral objection to nuclear energy. But *if* it is true that wastes can be buried in stable geological formations deep under ground, so that they are no more threat to the human race than the "natural" deposits of plutonium and other radioactive substances of Gabon, the moral issue changes. We must still, of course, ask about the costs of disposal and figure them into the costs of energy production, but we are not inflicting irreparable damage on posterity. In fact, we *may* be kinder to posterity than if we renounce nuclear energy and exhaust the natural resources of fossil fuels.

Here is another case where sound ethical judgment depends upon sound scientific judgment. No religious ethic can leap to a conclusion independent of scientific findings. The diversity of scientific opinion is due partly to insufficient evidence at this stage of work. It is due partly to differing ideological bents among scientists. For this reason church agencies, trying to make responsible judgments, will draw scientists into their conversations, both to learn from them and to question their assumptions.

One further comment on risk comes directly from the theological tradition. It is a warning about human fallibility and sin. Any human power can go wrong through accident and lack of foresight. And any human power can become destructive because of human arrogance and will to power. People who have power – whether military, economic, psychic, religious or technological – are likely to trust *themselves* with that power. It is already easy to see the *hubris* of some nuclear scientists and engineers of a decade or two ago – not because they were worse people than any others but because they were sometimes overconfident of themselves and their enterprise.

This awareness of fallibility and sin will color any Christian assessment of human power, including technological power. It might lead to a judgment that some technologies are too dangerous to develop. It did not lead to that judgment about such risky inventions as the automobile, the airplane, electrically-wired houses, surgery, chlorination of water and others. There is a deep human – and Christian – impulse to take risks in the exercise of human power. It is human – and Christian – to act out of hope as well as fear. It is ethically important that decisions about anything so promising and perilous as nuclear energy be made in the full light of day with wide participation of the people concerned. Their decisions will grow out of their ideology, their scientific understanding and their faith.

Last of all, I want to ask what it means for churches – and especially for the World Council of Churches – to make a prophetic witness on so complex an issue as nuclear energy.

One of my students, after reading some WCC documents on this issue, wrote: "Why is it that the WCC would not 'take a stand' on the nuclear question? Shouldn't the church be a leader rather than wait until the issue is already decided?"

Similarly, a Dutch television interviewer asked the WCC delegation at the Salzburg Conference on Nuclear Power (May 2-13, 1977): "Since the WCC is opposed to racism and militarism, why isn't it opposed to nuclear power?"

My first reply is to try some different questions: Since the church condemned Galileo, why shouldn't it condemn nuclear energy? Since the church once rejected contraceptives, why should it not be equally forthright today?

The questions suggest that the churches sometimes talk too quickly and confidently, just as they sometimes talk too slowly and timidly. The same questions also raise an underlying question: How far does the church function as a *magisterium*, a teaching authority telling its people what to believe and how to behave? And how far does it operate as a community, heightening moral concern and trusting its people to use their own ethical judgments?

I do not have simple answers for these questions. I believe that the church has a prophetic ministry, but that is not the same as having answers to all questions. I note that in the Bible those whom we now call false prophets rarely showed any self-doubt. The true prophets sometimes kept silence because they did not have a word from the Lord. But they consistently called for social justice and advocated the cause of the poor.

I know churches that are ashamed because they waited so long to oppose injustice and oppression. In my country we wonder how so many churches could have tolerated slavery for so long. I also know churches that are embarrassed because they talked too much and too soon. In my country the National Council of Churches wishes that it had not, on Feb. 23, 1961, "agreed in condemning abortion or any method which destroys human life except when the health or life of the mother is at stake" – not because the NCC has become enthusiastic about abortion but because it sees perplexities in the issue that once it ignored.

Can it be that the WCC has no word from the Lord on many a subject, that it believes it has a word from the Lord on some issues of social justice, that it hears a call to explore the meaning of responsible actions on some technical and social frontiers?

I should think that the WCC, facing some issues, wants to take a stand that will be offensive to its critics. Racism is a good example. I should think that on some other issues it wants to seek conversation among people who disagree, hoping for mutual education.

The WCC and Nuclear Energy

With this distinction in mind, let us ask where the WCC stands now. It has conducted a "Hearing" (Sigtuna, 1975) and published the findings of that process. It has continued its studies through committee processes, and again the findings have been published.

None of these publications speak for the WCC. But in 1977 the Central Committee voted to authorize its subunit on Church and Society to make the presentation to the International Atomic Energy Authority (IAEA) at Salzburg (1977)* on the basis of an abstract presented to the Central Committee. The Salzburg presentation is considerably expanded from the abstract, and the Central Committee is not responsible for the details. But in its general tenor that Salzburg statement represents the WCC. As one of those who helped to write that statement, I now look at it to explore its ways of relating science and faith.

First, I see some unambiguous ethical declarations. The statement insists that increased energy cannot be a substitute for justice or for a style of life emphasizing values other than consumption. It relates energy to "the struggle for a new and more just international economic order". It calls for "the widest possible public discussion" of issues, insisting that "every human being has a voice and a stake" in the issues being decided. It attacks the use of devices like the Non-Proliferation Treaty to protect the "proprietary interests" of some countries while holding others in deprivation. On such issues the statement, while not quite claiming

* See Anticipation, No. 24, Nov. 1977.

the authority of prophecy, aims to speak the mind of a church that lives in the succession of the prophets and apostles.

On another set of issues, connected with the practicality of nuclear energy, the statement is more reserved. Here there is no clear prophetic and apostolic heritage. Member churches of the WCC and members of the member churches have divergent opinions, depending on differing social situations, needs and scientific opinions. Even so, the process of discussion has brought some consensus, cutting two ways:

(1) There is a warning that "the maturity of the nuclear energy system is not yet such as to justify its world-wide application". The warning calls attention to several risks of nuclear technology and especially of the fast breeder reactor.

(2) There is the recognition that nuclear power is a reality, that its discovery will not be undone, that it is "one of several possible options for the future in many countries" – even though its availability should not "disminish the search for alternative, long-term, safer forms of energy". At this point some people would have preferred that the WCC give a sharp *yes* or *no* rather than so qualified a *yes and no.* But Christian faith gives clearer warranty to addressing issues of justice than to assessing diverse scientific opinions.

Finally, the statement makes a theological testimony. What can be said by a WCC to a United Nations body like the IAEA, diverse in its religious and ideological pluralism? The question is important, not only in its tactical demands for such a situation but also in its meaning for the self-awareness of the church in this pluralistic world. So the statement recognized that "no one religious perspective can be accepted today as the spiritual basis of a new world-wide concern for humanity", and it called for "conversation among people of diverse faiths and ideologies". Even so it called for all people to recognize "that they are not God, that their power has its limits, that not all problems yield to technological solutions, that humanity must learn to live with nature as well as to harness its resources". (Note that the WCC cannot ask the UN to confess belief in God; it can ask people to recognize that they are not God.)

Implicit in this theological position is a recognition, not always present in the church, that human beings today face ethical questions that inherited faith alone will not answer. Christians need knowledge, experience, insight from many sources. Their faith heightens their sensitivity to injustice and their awareness of the situation of the victims of injustice. This faith warns them against idolatries, including the idolatry of the "technical fix" as a solution to deep human problems. This faith combines a concern for human material welfare, with a warning against confidence in treasures on earth. It calls for conservation and sharing of resources. It offers some guidance and some poise for living with risk.

To expect more explicit ethical direction from faith or to expect less of faith is to reject its call to adventure.

NUCLEAR FISSION – A PERIL AND A HOPE

*Victor Weisskopf**

Forty years ago Hahn and Strassman discovered fission. The existence of this phenomenon could have been predicted before it was found if the theoretical physicists at that time had had a little more intelligence. Obviously, the Coulomb repulsion increases with the square of the number of protons, the nuclear attraction only with the first power. In 1938 enough was known about the nuclear force so that it would not have been too hard to conclude that the nucleus must become unstable against a split into two parts around Z=90.

This discovery came at a dark time in the history of mankind. Germany was in the grip of a collective mental disease of unparalleled virulence; only a few people in Germany, apart from the victims of the rage, were able to keep their minds immune from that disease. That those few existed, however, should give us some faith in mankind.

Although the fission process itself was not foreseen, the possibility of a nuclear chain reaction was indeed being thought of in the early thirties by L. Szilard. The implementation of such a reaction with fission depended upon the number of neutrons released in the process. This number was not easily predictable; even today it would be hard to determine it theoretically from our knowledge of the nuclear forces. That this number is considerably larger than unity does not seem to be based upon any fundamental property of the nuclear forces. It is an accident, there is no deeper reason, it might have been less than one, but wasn't.

The fact itself (that the number of neutrons emitted per fission is around two) is seemingly of very minor importance for Mother Nature. Apparently the only major role of the fission process is to provide an upper limit to the atomic number Z, and to influence to some extent the abundance of fission products. Apart from this we may forget about fission, if we are interested only in the major features of our world. This is even more true about the chain reaction itself. Nature has not made much use of it; recently evidence was found that a natural chain reaction happened a billion years ago below the soil of Africa; but to our knowledge, it never played any role in the development of our universe.

Do we humans count in this universe? If we do, my previous statement is totally wrong. For humankind the existence of this chain reaction is of decisive importance, probably greater than we can fathom today. We know that fission can be used as a destructive explosive and as a source of useful energy. It therefore is a very effective instrument of power, political power and physical power.

---

* Professor of Nuclear Physics, M.I.T. Talk given at a session of the American Physical Society commemorating forty years of fission, April 24, 1978, Washington, D.C.

This in itself is nothing new in the history of the natural sciences. Every so often new discoveries have led to new weapons, to new energy sources, and to countless applications from which a lot of good has emerged and also some results that have not been so good (in the last 20 years it has been fashionable to emphasize the "not so good", but let us be objective and fair). There is indeed something different in the latest developments of physics which I would call "the leap into the cosmos". Previously we were mostly dealing with processes similar to those occurring in our terrestrial environment. In the last few decades, however, we have made a decisive step; we now deal with extraterrestrial phonomena. Nuclear physics and subnuclear physics deal with the excitation of quantum states that are beyond the reach of ordinary terrestrial energy exchanges; nuclear reactions do not take place on earth. Nuclear dynamics is dormant in our environment. Sure, natural radioactivity occurs on earth, it produces the heat in the depth of our planet, but the radioactive elements are the remnants of a very different age and of a different environment; they are the last embers of the cosmic explosion which produced terrestrial matter.

Today we physicists are dealing with cosmic processes, in which many millions of electron volts per atom are exchanged rather than the few electron volts that are customary here on earth. And the fission chain reaction was one of the first of these cosmic processes which led to major technological applications. Two hundred million electron volts per atom, twenty million times more than the most powerful chemical reaction. We now are playing with cosmic and not ordinary fire. And the first major application was a destructive one which ended the Second World War by killing a quarter of a million people with two bombs. It is not surprising therefore that the world is aghast with horror and fear, even in regard to the more benign applications. The arm of technology grew by a factor of a million within the lifetime of one generation.

In 1940 we took no time to speculate too much about these questions. The whole world was threatened by the expanding cancer of Nazism; the Germans discovered fission, they might have used it, if it had been usable at that time. Many of us physicists, those who were not yet too deeply involved in the development of radar which saved England from being destroyed, worked hard to understand more about fission; many of us hoped that the number of neutrons per fission would be low enough to prevent the making of a bomb. But it wasn't. A tremendous collective effort began. Within two years, the first nuclear chain reaction was produced under the leadership of E. Fermi; within another three years with the collaboration of many European physicists – a truly international effort – a nuclear bomb was developed. On July 16, 1945 the first nuclear explosion was set off in a desert of southern New Mexico, at a place called Jornado del Muerte, because a Spanish army persished there two hundred years ago. Human ingenuity succeeded in the release of cosmic forces which were hidden and unknown only 13 years earlier, before Chadwick discovered the neutron. Some of us saw this event which, at our observation post, had the intensity of 20 midday suns: an expanding fire ball, white, and then yellow and orange, majestically rising into the sky, surrounded by a halo of blue light, the air fluorescent with radioactive radiation.

Here it was. The laws of nature did admit an explosive nuclear chain reaction. Because of some little detail in the equations of nuclear matter the number of neutrons per fission was large enough. The history of mankind took a turn. As Oppenheimer said (A.D. Little Lecture, M.I.T. 1948):

> *"In some sort of crude sense which no vulgarity, no humour, no over statement can quite extinguish, the physicists have known sin; and this is a knowledge which they cannot lose."*

From then on, political developments, and no longer scientific ones determined the course of events. Two bombs were exploded over Japanese cities; over 200,000 people lost their lives. Why two bombs? Why over populated areas? I am not sure I can answer these fateful questions. The bombs ended the war; they made an armed invasion unnecessary and thus perhaps saved more people than they killed. But Japan may have given up anyway under the pressure of a near-defeat and a Soviet declaration of war. Nevertheless, the stigma has remained upon the U.S. as the first and only country to have used nuclear bombs. I am not here to tell you what was right or wrong because I don't know.

The war ended – it was physics that helped to win it with radar and the atom bomb and many other new gadgets. Physics and the physicists moved into the centre stage of public life. The significance of basic physical science was generally recognized. New means of research suddenly were available to physicists, technically and financially. The radar technology has created sophisticated new methods to produce electromagnetic waves of all kinds. Maser and laser physics emerged from it, and with it a deeper understanding of fundamental quantum electro-dynamics, and of the structure of solids under various extreme conditions. Nuclear and subnuclear research experienced an almost explosive development with ever-growing cyclotrons, synchrotrons, linear accelerators and the like. The cosmic scope of physical research widened and penetrated into new realms of phenomena: on the one side into the giga-electron volt region with its mesons, hyperons, antiparticles, heavy electrons, and quarks, entering the innermost structure of matter; on the other side into plasma physics, space physics, a new cosmology and astrophysics with its quasars and pulsars, and the observation of the optical reverberation of the birth of the universe.

The physicists experienced a tremendous surge of support for their activities. It led to an unparalleled expansion of their fields of endeavour, and to a large range of new technical applications, destructive and constructive, such as fusion bombs, rocketry, transistors, space travel, computers and many more. The physicists also moved to the centre of public attention. It was their enthusiasm and self-confidence, spurred by their successes during and after the war, which brought them in contact with the great social and political problems of the times. Many tried, and some succeeded, to bridge the "communication gap" between politicians and scientists. They were attracted by the great and optimistic ideas of how to establish a new order in the world which they had helped to engender. They embraced the idea of international control of nuclear explosives which they hoped would stop all future wars and direct the applications of fission and fusion away from destructive bombs and towards an unlimited benign source of energy for all mankind. Perhaps it was also for some a reaction against a certain feeling of guilt for having been involved in the creation of something that could annihilate all mankind.

The political realities, however, were different and not conducive to the ideals of those who tried to unite the nations. Stalinism in the Soviet Union, the forces of nationalism all over the world including our own country, led to a breakdown of attempts to lift nuclear matters beyond national sovereignty. Of course, neither the physicists nor the politicians had much experience in how to deal with such complicated technical matters on an international scale. The nuclear arms race began in earnest; the fusion bombs were developed.

There was still left the great promise of unlimited benign sources of energy through the use of fission reactors and, perhaps later, through controlled fusion. But over the decades following the Second World War, doubts have been raised even on that account. Since the yield per atom is so many million times higher than in any conventional way of producing power, the consequences of accidents caused by human error are much worse. Sure, a nuclear power station cannot explode like a bomb, but it could spread large amounts of radioactivity in accidents which cannot be completely excluded. Even if human ingenuity and care could keep the accident rate at an acceptable level, the public and some of the experts have looked with some anxiety at this "extra-terrestrial" way of producing energy in our terrestrial abode. This anxiety has been strengthened by the fact that the public was acquainted with that cosmic force only via the experience of nuclear bombs. Furthermore, the use of fission for power constantly creates new raw material for bombs which, in a nationally and politically divided world, adds to the danger of further spread of nuclear weapons.

The dangers and the promises of nuclear power generators are today in the centre of discussion. Many studies have been undertaken and more are underway. Unfortunately emotion and vested interest have led to a sharp division of opinions and the arguments used on both sides are too often beyond the limit of dignified scientific discourse.

At the same time the nuclear arms race between the super-powers continues in an almost uncontrolled way. The Soviet Union and the USA assemble more and more bombs, and perfect their efficiency and their mode of delivery. Both powers now have the capability of destroying the other country many times over. Current science is totally unprepared to discuss intelligently, let alone to predict the totality of horrors which would result from an all-out nuclear war. Consider only the effects of the vast amounts of radioactivity released upon our environment; they would be so devastating that the conditions of life would be permanently and dangerously altered, without much hope of recovery. Even the detonation of a single weapon of modern design over a city would be a catastrophe unprecedented in human history. Under these conditions imagine two large countries keeping ready ten thousand of these horrendous means of annihilation, knowing well that any actual use of these devilish gadgets would mean certain destruction of a large part of them and us, with little chance of a recovery of civilization. Why? Why? Why? Only because neither side knows where to stop and both go on producing nuclear weapons intended for all sorts of real or imagined missions. Only because both parties are in the grip of an unrealistic measure-counter-measure syndrome. It is the apotheosis of irrationality and antilogic, the triumph of craziness.

The nuclear power controversy dwindles to picayune dimensions compared to this overwhelming threat. What are the dangers of nuclear power stations compared to the dangers of tens of thousands of bombs that can be released within seconds by a group of human beings. What is the so-called "worst reactor accident" compared to nuclear war? The damages done by the former which would come mainly from effects of radiation, serious as they are, are far less than the effects of a single bomb. Now think of the number of victims of a nuclear war and its irreparable effects on our environment, on our souls, alive or dead, and on our planet as a whole. And the probabilities? Nobody really can estimate the probability of an all-out nuclear war, but one fact is clear: with all those bombs around, it is not zero. Nuclear power may be too risky, or not; I do not pretend to know the answer. But I *know* that tens of thousands of stored bombs are too risky.

Sure enough, it is extremely improbable that the U.S. or the Soviet government will decide outright to set off a nuclear war, and to annihilate both countries simultaneously. But a nuclear clash may develop from local wars between smaller countries that have acquired or will soon acquire a few nuclear weapons and may make use of them in desperation. Or it may develop from an escalation of the use of so-called tactical nuclear weapons which are meant to be applied in defense against aggression by conventional weapons. The tens of thousand nuclear bombs are a mighty tinderbox which may explode whether we have directly intended it or not.

I am only too well aware of the difficulties in the way of reducing that danger. I know also that the presence of these weapons is given credit for preventing a so-called world-war for a longer period than ever before. But, as time passes the weapons multiply, get bigger, more efficient and, therefore, more likely to be used. The outbreak of a volcano becomes more violent after long pauses. This is a man-made volcano: it could be removed.

I used the word "almost uncontrolled" when I talked about the nuclear arms race. There were indeed a few hopeful attempts, albeit small and tentative, that slowed it down a little bit. One was the cessation of bomb tests above ground, the other was the first SALT agreement six years ago which, hopefully, will be expanded in the near future. It isn't much, but here are two small steps in the right direction and we can be proud that some of our colleagues have been active in bringing them about.

The difficulties of going further are enormous. There is the constant fear raised by some that the other side will gain more or might even dare to take the tremendous risk of a first strike regardless of the consequences. There are those who say that a free society cannot compete in terms of nuclear armaments with an authoritarian system in any other way but through an all-out technological arms race. Voices are heard that we should not be too confident of negotiated contracts with our opponents; that we should rather assure a reasonable survival rate by a large effort of organized civil defense in order to make the population as ready as one can be for the great holocaust. I honour the intentions of those who advocate such measures but I cannot help sympathizing with the majority of our population, who do not want to live under a constant conscious awareness of mankind's ultimate self-destruction.

We cannot go on forever living under a continuous threat of annihilation. There must be ways and means to decrease the level of nuclear bombs. Certainly this task cannot be accomplished from today to tomorrow; it is bound to be an extremely difficult process. It can only succeed if it is constantly pushed and prodded by much more public discussion, support and pressure than it receives today.

There is a hope and not only a peril in the nuclear development. It is still possible that the growing recognition of this awful threat will change the attitudes of sovereign states and will slowly lead to the recognition that ultimate military preparedness is much less safe than a reduction and eventual abolition of nuclear weapons. I quote Oppenheimer again, who said in 1945 shortly after the end of the war:

> *"The point is that atomic weapons constitute a new field and new opportunities... when people talk of the fact that this is not only a great peril, but a great hope, this is what they should mean. I do not think they should mean the unknown, though sure, value of industrial and scientific virtues of atomic energy, but rather the simple fact that, because it is a threat, because it is a peril and because it has special characteristics there*

exists a possibility of realizing, of beginning to realize, those changes which are needed if there is to be any peace".

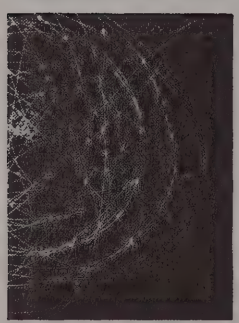
This is not the place to make specific proposals but the lack must be faced. It is the first and foremost problem of our time. Any one of us can and should play a role in this task as a scientist, and as a human being. We must find the right balance of risks which is conducive to lowering the levels of nuclear armaments. What is needed is a combination of new technical ideas and common sense based upon humane considerations. The most important step is a new setting of priorities. The reduction and eventual abolition of nuclear weapons *must have absolute priority;* everything else must be subordinated to this goal. The consequences of nuclear war are irreparable, the consequences of other setbacks in world politics can be corrected. There are too few of us who really worry about these issues, which remain our foremost responsibility as physicists and citizens.

Only when we see a chance of success in the abolition of nuclear armaments can we scientists be proud of our achievements gained during the last decades, of our leaps into the cosmos, of our penetration into the innermost structure of matter and into the basic processess of life, the workings of DNA and RNA, and of the tremendous developments in our knowledge of organized matter.

It is not the first time in history that human greatness and human folly grew side by side in the same period. Think of the gothic cathedrals and the senseless and murderous crusades 700 years ago; think of the blossoming of art and philosophy during the Renaissance and of the decimating of Europe's population during the religious wars 500 years ago; think of the music of Mozart and Beethoven and of the slave ships plying the oceans 150 years ago; think of the greatest achievements of scientific thought such as Quantum mechanics and Relativity theory, and of the murderous periods of Nazism, Fascism and other authoritarian regimes, 50 years ago; finally, think of the great achievements of science today together with the folly of the nuclear arms race.

The last folly is more serious than the previous ones. We are dealing with cosmic forces. It may be the end of what has been a great age of mankind, great in spite of all strife and wanton destruction. Great in what it has achieved in art, architecture, literature, music; in its numerous social innovations, in spite of the fact that in most parts of the world social organization and the quality of human life leave much to be desired; great in its medical successes resulting in the doubling of the average age of man; great in its means of food production, communication and transportation, which make a united world without hunger and want a possibility, if not a reality. And last but not least, a great civilization because of the constant growth of our insights into the mysteries of nature, a continuous opening up, leaf by leaf, of the blossoms of truth and wonder.

If we do not succeed in abolishing the nuclear arms race and a nuclear war results, all these great steps will be brought to naught. The 20th century will be remembered as the time of preparation for the great catastrophe and science will be seen as the main culprit and the main instrument of destruction. The 20th century ought to be and should be remembered as the age in which mankind acquired its widest and deepest insights into the universe and was able to control its martial impulses. Let us hope, strive and act so that it will.



SHOULD RADIATION EXPOSURE FROM THE OPERATION OF NUCLEAR POWER PLANTS BE REDUCED?

*Karl Z. Morgan**

Who Raises This Question?

Many individuals, citizens' groups, environmental organizations, and church bodies are raising this question. In the United States the Natural Resources Defense Council has petitioned the U.S. Nuclear Regulatory Commission and the U.S. Environmental Protection Agency to reduce the maximum permissible exposure (MPE) level for occupational workers by a factor of 10 (i.e., reduce the level for whole body exposure from 5 rem/y to 0.5 rem/y). The National Council of Churches of Christ held meetings in Stony Point, New York, U.S.A., October 12-14, 1977 at which time the whole question of choices of energy for public use were discussed, nuclear power was rather strongly criticized and at present a policy statement of the NCCC is in preparation. On March 10-12, 1978 my own church, The Lutheran Church in America, held a Nuclear Energy Working Consultation in Madison, Wisconsin, U.S.A., and now here in Bossey, Switzerland we are assembled at the World Council of Churches Consultation on Ecumenical Concerns in Relation to Nuclear Energy.

Our concern at these meetings must not be limited to nuclear power, however, because we are called upon to make wise choices among a number of power sources – nuclear, coal, oil, gas, solar, geotherm, hydroelectric, wind, tides, ocean thermal gradiants and biomass, and each source of energy presents its own brand of problems – social, economic, radiation, chemical pollution, genetic risks, cancer, etc. It is difficult to find answers to some important germane questions which we must ask because of serious limits of human experience due in considerable measure to channeled research and biased industrial development which has taken place.

For example, we do not know how far we can or should go with nuclear power because we cannot predict when or if fusion power will find its way through a maze of difficult problems. We know the life of the present burner reactors is

* Neely Professor, School of Nuclear Engineering, Georgia Institute of Technology, Atlanta, U.S.A.

very short (decades) because of limited uranium resources and some of us question the acceptability of the present breeder program because of serious shortcomings we perceive in the LMFBR Liquid metal fast breeder reactor. There are similar problems with fossil fuel. For example, how much should we bank on shale oil or what would be the total cost (including all the health effects) of our electric power if it depended primarily on coal? Who can say at this point how much power we can count on from geotherm in the year 2020 or what will be the cost of devices for direct conversion of solar to electrical energy after a few decades of intensive research and practical experience? Or maybe some of us are bold enough to try to describe the kind of transportation system we will have in the year 2020. Doesn't it seem odd that we know far more about the carcinogenic effects of ionizing radiation than about the effects of NO_x, SO_x, CO_x, hydrocarbons and particulates from fossil fueled power plants and gasoline guzzling automobiles?

The question of "Should radiation exposure from operation of nuclear power reactors be reduced?" must be considered along with other important related questions such as "What power mix is most desirable?" and "Is nuclear power acceptable?" Many members of the public answer this latter question with a *yes* or *no*, but my answer is *yes with some provisos*. In no case is it fair to insist on reducing radiation exposure limits in the operation of nuclear power plants without applying these limits to the other areas of human exposure. In the U.S. with over 10% of our electric energy supplied from nuclear plants much less than 1% of the average dose from man made sources of ionizing radiation derives from nuclear power sources while more than 90% is received from medical applications. Were we to completely eliminate the nuclear power industry to the end of the century, this would reduce the population dose (man.rem) and the corresponding somatic risks (mostly cancer) and genetic mutations less than would a 1% reduction in our average dose from medical applications. I believe it is not only unscientific but immoral if we, in our efforts to reduce these risks, do not devote a major portion of our attention to reducing unnecessary medical exposure. I[1] and many others [2] have shown that medical exposure in the U.S. (and probably in most countries) could be reduced to 10% of its present level while at the same time bringing about an impro-

TABLE 1. CHANGES IN LEVELS OF PERMISSIBLE EXPOSURE TO IONIZING RADIATION[(b,e)]

FOR RADIATION WORKERS:

Recommended Values		Comments
0.1 erythema dose/y (~1R/wk for 200 kV x-ray)	52 R/y[(a)]	Recommended by A. Mutscheller and R. M. Sievent in 1925. This was recommended by ICRP in 1934 and used world-wide until 1950.
0.1 R/day (or 0.5 R/wk)	36 R/y	Recommended by NCRP on March 17, 1934.
0.3 rem/wk	15 rem/y	Recommended by NCRP on March 7, 1949 and ICRP in July, 1950 for total body exposure.
5 rem/y	5 rem/y	Recommended by ICRP in April, 1956 and NCRP on January 8, 1957 for total body exposure.

FOR MEMBERS OF THE PUBLIC:

0.03 rem/wk	1.5 rem/y	Suggested by NCRP in September, 1952 for any body organ.
0.5 rem/y	0.5 rem/y	Suggested by NCRP on April 15, 1958 and by ICRP in July, 1959 for gonads or total body.
5 rem/30y	0.17 rem/y	Suggested by ICRP on September 9, 1958 for gonads or total body.
25 mrem/y	0.025 rem/y	Suggested by USEPA[3] on January 13, 1977 for any body organ except thyroid.[(c)]
5 mrem/y	0.005 rem/y	Suggested by USERDA in 1974 for persons living near a nuclear power plant.[(d)]

NOTE: (a) 1 R $\simeq$ 0.88 rem.
(b) See Reference 4 for additional information.
(c) The limit set by EPA for the thyroid was 0.075 rem/y.
(d) Present radiation protection guide of the USNRC.
(e) This table is taken from a paper by the author (K. Z. Morgan) to be published in the Bulletin of Atomic Scientists[5].

vement in medical applications of ionizing radiation. I have striven (perhaps "fought" is the proper word) for over a quarter of a century to reduce unnecessary medical exposure but can count on the fingers of one hand the few milestones of success we have had: 1- Four (of our 50 states) require X-ray technologists to have education, training and certification in radiobiology and health physics, 2- One of our states (California) requires questions on the state board examinations on these subjects, 3- Elimination of mass-chest-X-ray programs, 4- Restrictions on use of X-ray mammography, and 5- Establishment of upper dose limits for the common X-ray diagnostic procedures.

Why Is This Question Raised?

The answer is straightforward, namely the risks from radiation exposure are much greater than they were considered to be a decade ago; the only uncertainty is how much greater are these risks and what are their absolute values. The gradually increasing awareness that risks from exposure to ionizing radiation are greater than they were considered to be in the early period is indicated by the stepwise reduction in the level of maximum permissible exposure (MPE) as recommended by the International Commission on Radiological Protection (ICRP), the National Council on Radiation Protection (NCRP), the U.S. Environmental Protection Agency (EPA) and the U.S. Energy and Research Administration (USERDA) as indicated in Table I.[5] Here it is noted there has been a drop by a factor of about 10 in the MPE for occupational workers and by a factor of 300 for members of the public.

During the first part of this atomic age (1942 to 1960) most scientists and members of the public who were versed in radiobiology and health physics believed in and accepted the threshold hypothesis; namely, no harm will be done or radiation damage will be repaired as fast as produced so long as a certain threshold dose is not exceeded. Since 1960, however, there has accumulated an overwhelming mass of data which show the threshold hypothesis is not tenable, that there is no so called safe level of exposure and no dose can be so low that the risk of radiation damage (even damage such as fatal cancer) is zero. The risk is simply one of chance that one of the billions of ionizing particles that strikes the body during a small exposure (there are about 2.2 billion photons per cm^2 for one rad of X-rays at 1 MeV) will produce a change in a single cell of the body such that it survives in its perturbed form to grow into a clone of cells that 5-10-50 years later is diagnosed as a malignancy. Thus the risk we take, even from a low dose of ionizing radiation, is similar to the chance one assumes each trip one takes in a taxi (i.e., small but not negligible and the risk is proportional to the exposure or the miles traveled in the taxi).

In the early period everyone seemed to take for granted that somatic risk (cancer, life shortening, cataracts, etc.) was small compared with genetic risk and thus the limiting factor in setting values of MPE was the genetically significant dose. Now, however, it is recognized that the somatic risk may be as great or greater than the genetic risk. For example, the Committee on the Biological Effects of Ionizing Radiation (BEIR)[6] stated, "until recently, it was taken for granted that genetic risks from exposure of populations to ionizing radiation near background levels (~100 mrem/y) were of much greater import than were somatic risks. However, this assumption can no longer be made if linear nonthreshold relationships are accepted as a basis for establishing cancer risks." ICRP[7] made an equally informative statement in one of its working papers: "It could be concluded that the radio of somatic to genetic effects after a given exposure is 60 times greater than was thought 15 years ago."

Not only have our views regarding somatic risk changed from year to year but our evaluation of the genetic risk has undergone considerable vacillation. Apparently in the early period, many studies of H. J. Muller convinced all of us that genetic damage increases linearly with the gentically significant dose. Then in 1965 Russell[8] showed that for low rates of exposure of mice (below 5000 R/hr) and for low doses the mutation frequency (mutations/locus.gamete.R) was only about 10% of that at high doses and dose rates. Until 1972 most standards setting bodies took advantage of this genetic safety factor of 10, but then Lyon et al.[9] and Abrahamson and Wolff[10] showed the genetic risk for mice (and presumably for man) should be pushed up at least by a factor of 4 at doses of around 0.6R/hr. It may be that at very low dose rates there is no genetic safety factor and perhaps now we should be conservative and assume complete linearity of genetic damage with dose as did Muller.

I had the good fortune of becoming closely associated with Muller during the years we were active on ICRP putting up a battle to reduce the number of diagnostic X-rays taken in the pelvic and abdominal region of women in the childbearing age. Could he be here in person today, I am sure he would caution us that the BEIR Committee[6] underestimated the genetic risk – especially for the recessive, nonvisible or small mutations. He emphasized that there are 10,000 of these small mutations for every visible one and that in the long run they may be far more harmful to man because they remain in the gene pool so long and result in such things as susceptibility to disease and slight reduction in mentality and physique, etc.

During the past few years there has been a number of epidemiological studies[11,12,13,14,15,16,17,18,19] of human populations to determine the risk of various types of malignancies at low doses below the present occupational MPE. Table 2[5] summarizes a small number of these studies, all of which lend support to the non-threshold hypothesis. I say non-threshold rather than linear hypothesis because a number of studies[24,25] – especially those for high LET radiations (high - dE/dx) such as α or neutron, those for exposure of the young and the older members of the population and for all types of solid tumors – have shown the linear hypothesis is either applicable or non-conservative. At the present time, it appears that perhaps only the risk of leukemia to middle aged persons conforms to a threshold hypothesis. As seen in Table 2 the linear hypothesis (or a more conservative non-threshold hypothesis) applies down at least to 0.8 rad for exposure to the fetus in the induction of leukemia and other cancers and down to 6.5 rad for the induction of thyroid carcinoma in children. It should be emphasized that these are not the doses below which the linear or non-threshold hypothesis no longer applies but rather the lowest average doses for which there are low level human exposure data of statistical significance, and there is every reason to believe the risk of cancer per person.rem is as great or greater at lower doses. It should be noted also that the 0.8 rad is only 5% of the 15 rem/y value of MPE for exposure of active (red) bone marrow of the radiation worker and the 6.5 rad is only 22% of the 30 rem/y permitted to his thyroids. Also, it should be noted that the overall cancer risk seems to be about 6×10^{-4} cancers/person.rem. This would mean that if 100,000 occupational workers each received an average of 0.5 rem/y (or 10% of the MPE) over a period of 20 years, we would expect 600 radiation induced cancers or a 0.6% incidence of cancer from this exposure. This would be only 3% increase in the 20% risk a person normally has of dying of cancer, but I believe it is by no means a negligible or an insignificant risk. It may, however, be an acceptable risk if reasonable efforts have been taken to minimize this risk,

TABLE 2. CANCER RISK AND KNOWN RANGE OF LINEARITY[a]

Linearity of Dose Down To:	Risk Per Person Per Rad	Comments	References
< 10 Rad	$0.3 - 1.0 \times 10^{-4}\ell$ $0.5 - 1.7 \times 10^{-4}C$	Hiroshima and Nagasaki atom bomb survivors	6, 20, 21, 22
Av. 370 Rad	$0.2 - 0.3 \times 10^{-4}\ell$	Ankylosing spondylites patients	6, 17
0.2 – 0.8 Rad	$3 \times 10^{-4}\ell$ $6 \times 10^{-4}C$[b]	Pelvimetry Exposures – Stewart and Kneale	11, 17
~ 1.0 Rad	$3 - 30 \times 10^{-4}\ell$	Pelvimetry Exposures – Bross et al	23, 24
20 Rad	$0.5 - 1.1 \times 10^{-4}T$	X-Ray Therapy – Hempelmann	12
6.5 Rad	$1.2 \times 10^{-4}T$	X-Ray for Tinea Capitis – Modan et al	14, 15

(a) This table is taken from a paper by the author (K. Z. Morgan) to be published in the Bulletin of Atomic Scientists.

(b) Data of Bross,[23,24] Silverman and Hoffman,[15] Mancuso et al.,[16] Rotblat,[19] etc., now suggest this coefficient of 6×10^{-4} is probably a best present estimate of total cancer risk of the average man following total body exposure to ionizing radiation.

ℓ = leukemia risk/person.rad
C = total cancer risk/person.rad
T = thyroid cancer risk/person.rad

if the employees are well aware of the risk, and if work in this plant is as safe or much safer than in other industries that are considered to be well run and "safe."

Why Should the Christian Church Concern Itself with What Some Consider a Question of Science, Engineering, and Industry?

I consider this a legitimate question to put before the Church because I believe the primary purpose of the Church should be to preach the Gospel of Christ. However, as Christians we should, like Christ, face moral issues, try to remove injustice and correct inequities and remove suffering, hunger, and disease. If decisions of great significance regarding our available sources of energy are to be made that affect the happiness, well being and the very life of millions of people now living and even more persons yet to be born, certainly it is the Christians' duty to work hard to see that the right decisions are reached, and proper actions are taken. As indicated above, the question of proper values of MPE for the nuclear power industry must not be considered in isolation from a number of closely related problems. Some of these are the risk of a third world war, proliferation of nuclear weapons, international blackmail, pollution of man's environment and extinction of many species of God's creatures, overpopulation, mass starvation, hunger and disease and compromise of principles or loss of human pride, dignity, self respect, and freedom of worship.

Alternative Solutions

Time will permit me only to outline briefly why I believe the liquid metal fast breeder reactor (LMFBR) was a very bad choice and to indicate the direction in which I think we should move over the long range in the use of nuclear energy. I have opposed the LMFBR and the eventual wide distribution of such nuclear power plants because:

1. It contains a very large inventory of radionuclides of plutonium and large quantities of transplutonic radionuclides. These radionuclides are among the more dangerous materials known to man and rectification of mistakes in their use will have to be made over thousands of years. I believe these more dangerous materials can be kept essentially out of the human environment during routine operation of the LMFBR, and if we boldly transfer accident probabilities of the Rasmussen[26] report from their intended application to the light water reactor (LWR) to the LMFBR, the risk is admittedly small but still far from zero. Rasmussen's serious meltdown that could spread a few thousand curies of radioactive debris only once in 20,000 reactor years is indeed a low accident rate, but when we have 1000 operating LMFBR's, this would correspond to such a serious accident every 20 years. Even this may be too many accidents but the many evaluations of the Rasmussen report have convinced me the risk is at least ten times this figure for the LWR and it may be even larger for the LMFBR. Maybe a safer version of the plutonium burning breeder can be made safe enough for operation in remotely located reactor parks, but I doubt the wisdom of locating the LMFBR near population centers and under national or private control. I do not think we should permit the time to come when we might have one of these accidents every two years, especially if these LMFBR's are to be located closer than 100 km (62 mi.) from densely populated areas.

2. I do not like the positive void coefficient in the Na coolant. Some other breeder systems would certainly have a negative void coefficient.

3. I do not think the LMFBR looks very promising with a breeding ratio of less than 1.2 and a doubling time that is probably greater than 40 years.

4. I believe the world availability of reasonably priced uranium is often exaggerated.

The solution I favor is building large reactor parks where all the plutonium breeders or converters would be located. These parks would be under strict international control and would be located over a geological formation suitable for permanent disposal of the high level radioactive waste. My health physics group at Oak Ridge, Tennessee, U.S.A. did essentially all the basic and applied studies (in Kansas) on disposal in bedded salt, and I believe this formation provides a satisfactory medium for safe, permanent disposal. These international sites would reprocess spent fuel from LWR's and (HWR's) and "burn" the plutonium -239 and 241 in thorium blanket breeders or converters. The fuel from these reactors would be reprocessed on site and the three principle products of the center would be radioactive waste, uranium 233 and electrical energy. This latter would be transmitted at high potential to the power demand. Perhaps some of the electrical energy could be used for other purposes such as desalinization, production of hydrogen and aluminum. The uranium -233 would be denatured below weapons grade with uranium -238 and fabricated into fuel elements which would be shipped to burner reactors (LWR, HWR) closer to cities and not under such strict international control. The uranium -233 has many advantages. I think the two outstanding ones are: (1) it produces essentially no plutonium or transplutonic elements in the reactor in which it is used for fuel and (2) it greatly reduces the risks of proliferation and international blackmail. The uranium -233 is always accompanied by uranium -232 and 234 and these radionuclides result in very hard (high energy) gamma flux so that even if the uranium -238 were not present, it would be difficult to make it into weapons.* There would be close inspection by the International Atomic Energy Agency (IAEA) at each of the outlying nuclear power plants to see that all the spent fuel elements (containing small amounts of plutonium produced from the uranium -238) were returned to an international park for reprocessing and replacement by new U-233 - U-238 fuel elements.

As indicated above, there are some serious moral questions that must be considered as they relate to the levels of MPE; I will mention only three: burning out of employees, the dollar value of a human life, and the practice of suppressing information about the risks from exposure to ionizing radiation.

Burning out of temporary employees has perforce become a common practice at nuclear power plants and in fuel reprocessing plants (e.g., the one that operated at West Valley, New York, U.S.A.). By this we mean that for rather persistent "hot" operations (such as the high levels of cobalt-60 and 58 in the steam generators of the PWR) the local plant employees reach the MPE permitted and then to get the job done management brings in the temporary employees to spread out the exposure. After the utility has used up the MPE for its home office staff that are sent in to the plant, they literally hire untrained and inexperienced men off the streets who on hot jobs may be terminated after a day or so because they have in this time reached their MPE. *I consider this practice improper and immoral because:* (1) it is reported that many of these "temporary burned out employees" go from plant to plant doing the same kind of work but exceeding their MPE, (2) these employees do not, in general, understand or appreciate the risks of radiation exposure, and (3) the total population or man.rem dose is increased by this practice because inexperienced men usually get more dose for the same operation and because much of the dose is received going into and away from a hot operation and in adjusting equipment, face masks, etc.

It sounds blood thirsty to set a dollar value on a human life – especially if the life is our own or that of a loved one. However, this is exactly what we must do for many public works projects or in this case in setting values of MPE, albeit we wash our hands of any guilt because we do this by remote control or indirectly. This is what we do when perforce a dollar value is set on how much a company or a government agency is expected to spend to reduce one man.rem of exposure. Table 3[27] summarizes some of the values that have been recommended.

TABLE 3. COST OF A MAN.REM[27]

Author	Cost ($/man.rem)
Cohen, 1969	$250
Hedgran and Lindell, 1970	100
Dunster and McLean, 1970	~10*
Atway, 1971	200
Lederberg, 1971	100
U.S. Nuclear REgulatory Commission, 1976	1000

* a few pounds sterling, see Ref. (28).

Since, as indicated above, the cancer risk from exposure to ionizing radiation is about 6×10^{-4} cancers/man.rem, the cost the industry should be willing to pay at $1000/man.rem to prevent a single cancer is

$$\$1000/\text{man.rem} \div 6 \times 10^{-4} = \$1.7 \times 10^{6}.$$

It is interesting to note that the value suggested by Dunster and McLean[28] (both with the ICRP) would be only $17,000 to prevent a cancer. Far be it from me to set a dollar value per man.rem, but certainly $17,000 seems too low. On the other hand many industries such as bridge building and underground mining set values far less than $\$1.7 \times 10^{6}$. It seems obvious this dollar value has to be much less than the national budget, but how much less.

One practice that certainly should concern the Christian Church is that of suppressing scientific information or the practice of a government agency of supporting research only so long as the scientific findings lend support to preconceived opinions and positions established by the agency. Of course the agency would never admit this practice and the opportunities for a coverup are almost limitless. I am convinced this is a rather common practice from my own experience while working at Oak Ridge National Laboratory where a paper I was to present in Nuremberg, Germany in July 1971 had all reference to the LMFBR deleted by plant management. This paper showed that the fused salt breeder reactor was about 300 times safer than the LMFBR because it did not contain radionuclides of plutonium and transplutonic elements (i.e., it was a Th-U-233 thermal breeder).

---

* The use of Th-U-233 rather than U-U-233 fuel in outlying nuclear power plants would have several advantages such as no production of Pu-239 from U-238 and the use of more efficient Th-U-233 metal fuel rather than UO_2 fuel.

During January and February, 1978 hearings have been underway in our Congress (both in the House and Senate). From the testimony provided by numerous witnesses it would be very difficult not to draw the conclusion that the long delays in publishing the findings of Milham[29] were an effort to suppress information. Milham had uncovered a high mortality from cancer among the atomic energy workers at Hanford, Washington. Then the decision to cancel the University of Pittsburgh Program of Mancuso, Stewart and Kneal,[16] which confirmed Milham's earlier findings, aroused many suspicions. Our Energy Research and Development Administration (now Department of Energy) chose a very poor time to cancel this program and reestablish it inhouse at Hanford and Oak Ridge. Many persons interpret this as an effort to suppress the finding of a relatively high cancer risk among these workers. Also, as a result of these Congressional hearings one would find it hard not to agree with Bross that his Tri-state program was canceled by our National Institute of Health because of a bias of a peer review committee. Bross[24] had found from his research a 5000% increased risk of leukemia among children who had received in utero exposure and then before age 4 developed certain respiratory disease. He claimed that the peer review committee selected by NIH consisted mostly of radiologists who were angered because his data showing a high cancer risk from low exposure to X-rays and this finding was in considerable measure responsible for major modifications of the mass mammogram program radiologists had set underway in the U.S.A.

What Should Be Our Reply to Those Who Are Requesting the MPE Be Reduced by a Factor of Ten?

Each of us should examine the facts and decide his answer as best he can after asking God for a measure of divine wisdom and guidance.

I oppose the proposal for three reasons as I stated in the Congressional hearings:

1. I believe that although this would reduce the individual radiation doses received by the nuclear power workers, it would lead to an immediate increase in the man.rem dose as explained above and as shown by Golden.[30] In other words the practice of burning out temporary employees would be encouraged. This is exactly what we should try to avoid because this would mean an increase in the number of radiation induced malignancies.

2. Most of the population dose ($> 90\%$) from man made sources results from medical applications and there is much less than 1% from the nuclear power industry against which this proposal is primarily directed. I am reminded of Christ's caution of why behold the mote in our brother's eye when there is a beam in our own eye (Matt. 7, 3). Why not tackle first 90% of the problem and then the $< 1\%$? The medical professions are exempt from conformance with the values of MPE when it comes to the patient. Members of the medical profession insist on weighing the benefits of a given X-ray or radioisotope medical procedure and yet from my experience I find it unusual in the U.S.A. for a medical doctor to understand even the elementary principals of radiation protection or the chronic effects of human exposure to ionizing or non-ionizing radiation.

3. I believe if we reduced the MPE by a factor of 10, most of the LWR's and HWR's would find it necessary to shut down. This would cause serious disruption of our way of life, great inconveniences and discomforts, a serious increase in unrest and unemployment, and I believe instead of saving lives we would add greatly to the loss of life. In the long run it would bring about disastrous consequences in the less developed countries because then the more affluent societies would be the only ones that could afford to buy oil.

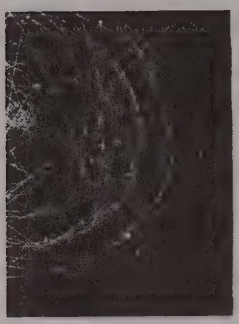
I proposed in the Congressional hearings that we take a mid course, namely:

1. Reduce the MPE by a factor of 2 (i.e., the MPE from 5 to 2.5 rem/y).
2. Set a limit of 200 man.rem/1000 MWeY for each reactor presently in operation and 50 man.rem/1000 MWeY for those under design and construction.
3. That we consider setting the MPE at 0.5 rem/y only after making certain it applies to all occupational exposure and as far as possible to medical exposures of patients and only after a careful evaluation of all the consequences should the MPE be reduced to 0.5 rem/y.

References

1. K. Z. Morgan, "The Need for Radiation Protection", *Radiologic Technology 44*, No. 6, 385 (1973)
   K. Z. Morgan, "Population Exposure to Diagnostic X-rays and the Resultant Damage Can be Reduced to 10% of Their Present Levels While at the Same Time Increasing the Quality and Amount of Diagnostic Information", testimony presented before the House of Representatives, Washington, D.C., on HR10790 (October 11, 1976)
   K. Z. Morgan, "Reducing Medical Exposure to Ionizing Radiation", Landauer Memorial Lecture at Stanford University, September 27, 1974; *American Industrial Hygiene Association Journal 36*, 358 (May 1975)
2. J. L. McClenahan, "Wasted X-rays", *Radiology 96*, 453 (August 1970)
3. Rules and Regulation, Environmental Protection Agency, Federal Register (Thursday, January 13, 1977)
4. K. Z. Morgan, "Maximum Permissible Levels of Exposure to Ionizing Radiation", proceedings of the International Summer School on Radiation Protection, Cavtat, Yugoslavia, available from the Boris Kidric Institute of Nuclear Sciences, Belgrade, Yugoslavia, *1*, 7 (September 21-30, 1970)
5. K. Z. Morgan, "Risk of Cancer from Low Level Exposure to Ionizing Radiation", to be published in *Bulletin of Atomic Scientists*
6. BEIR Committee, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation", Nat. Acad. Sc. & Nat. Res. Council (November 1972)
7. ICRP/71/L:C4-working paper of the International Commission on Radiological Protection (1971)
8. W. L. Russel, "Studies in Mammalian Radiation Genetics", *Nucleonics 23*, 53 (January 1965)
9. M. F. Lyon, D.G. Papworth and R. J. S. Phillips, "Dose Rate and Mutation Frequency After Irradiation of Mouse Spermatogonia", *Nature New Biology 238*, 101 (July 1972)
10. S. E. Abrahamson and S. Wolff, "Reanalysis of Radiation-Induced Specific Locus Mutations in the Mouse", *Nature 264*, 715 (1976)
11. A. Stewart and G. W. Kneale, "Radiation Dose Effects in Relation to Obstetric X-rays and Childhood Cancer", *Lancet*, 1185 (June 5, 1970)
12. L. H. Hempelmann, "Neoplasms in Youthful Populations Following X-ray Treatment in Infancy", *Environmental Research 1*, 338 (1967)
    L. H. Hempelmann, "Risk of Thyroid Neoplasms After Irradiation in Childhood", *Science 160*, 159 (1968)
13. R. E. Albert and R. E. Shore, "Follow-up Study of Irradiated Tinea Capitis Cases", presented at 100 Annual Meeting of the American Public Health Association (1972)
14. B. Modan, H. Mart, D. Baidatz, R. Steinintz, and S. G. Levin, "Radiation-Induced Head and Neck Tumors", *Lancet 1*, 277 (February 23, 1974)
15. C. Silverman and D. A. Hoffman, "Thyroid Tumor Risk from Radiation During Childhood", *Preventive Medicine 4*, 100 (1975)
16. T. F. Mancuso, A. Stewart and G. Kneale, "Radiation Exposure of Hanford Workers Dying from Cancer and Other Causes", *Health Physics 33*, No. 5, 369 (November, 1977)
17. A. Stewart, "Low Dose Radiation Cancers in Man", *Advances in Cancer Research 14*, 359 (1971)

18. B. MacMahon, "Prenatal X-ray Exposure and Childhood Cancer", *Journal of the National Cancer Institute 28*, 1173 (1962)
19. J. Rotblat, "The Puzzle of Absent Effects", *New Scientist*, 476 (August 25, 1977)
20. I. M. Moriyama and H. Kato, "Mortality Experience of A-Bomb Survivors 1970-72", JNIH-ABCC Life Span Study Report 7, Technican Report 15-73 (1973)
21. E. E. Pochin, "Malignancies Following Low Radiation Exposures in Man", *British Journal of Radiology 49*, 577 (July 1976)
22 ICRP Publication 8, "The Evaluation of Risks from Radiation", International Commission on Radiological Protection, Committee I Report, Pergamon Press (1966)
23. I. D. J. Bross, "Leukemia From Low-Level Radiation", *New England Journal of Medicine* 287:107 (July 20, 1972)
24. I. D. J. Bross, proceedings of a Congressional Seminar on Low-Level Ionizing Radiation, House of Representatives 94th Congress, reprinted by and available from the Environmental Policy Institute, 317 Pennsylvania Ave., SE, Washington, D.C. 20003
25. K. Z. Morgan, "The Linear Hypothesis of Radiation Damage Appears to be Non-Conservative in Many Cases", proceedings of the Fourth International Congress of the International Radiation Protection Assn., Paris, France, Paper No. 451, 11 (August 1976)
26. N. C. Rasmussen, "Calculations of Reactor Accident Consequences", USAEC-WASH-14 (August 1974)
27. J. J. Cohen, "On Determining the Cost of Radiation Exposure to Populations for Purposes of Cost-Benefit Analysis", *Health Physics 23*, No. 5, 527 (November 1973)
28. H. J. Dunster and A. S. McLean, "The Use of Risk Estimates in Setting and Using Basic Radiation Protection Standards", *Health Physics 19*, No. 1, 121 (July 1970)
29. S. Milham, Jr., "Occupational Mortality in Washington State 1950-1971", Contract No. CDC-99-74-26 (1975)
30. J. C. Golden, "Effect of a Change in Regulating Limits for Occupational Radiation Exposures of Manpower Requirements and Radiation Dose (Man.Rem) Experiences at a Nuclear Power Station", Commonwealth Edison Co. (December 16, 1975)



RADIOACTIVE WASTE MANAGEMENT

*P. J. Dyne**

"One blind man's view of the elephant".

Remember the fable of the twelve blind men describing the elephant. Each man could only describe the part he was touching and each was sure that he had the whole elephant. So it is, I am afraid, with practically everybody's view of the world energy problem and of nuclear energy in particular. In talking about waste management I am giving you my view of the elephant. In this discussion, I hope that we can combine the views of more than one blind man!

The debate on nuclear energy is, in essence, a question of ends and means. Do the ends justify the means? Here the *end* is the production of electricity; the *means* is nuclear energy. To me, the *technical* questions about nuclear power can be summarised in one word "radioactivity". As a technology it is unique in having to handle very large amounts of radiactive material in a concentrated form. Radioactive materials are mined and the mining residues exposed so that radioactive material in a concentrated form. Radioactive exposed to wind and rain. In the fission process in the reactor, very high concentrations of new radioactive materials are produced under conditions of high temperature and pressure. Finally, a fraction of this new radioactivity persists for a long time after the fuel is taken from the reactor.

In the simplest terms: there are three reasons why radioactive materials are of special concern:

- they are poisonous in very small quantities (and I use poisonous in a very general sense);
- they are persistent (they can't be destroyed);
- our natural senses don't warn us of their presence (as do hot things or sharp things, for example).

Do radioactive materials differ, in some absolute sense, from all other "poisons"? There are other materials which, one way and another, fit this general description. It happens that I don't see radioactivity as being all that different from other noxious materials.

Let me explain why I have that viewpoint. (My end of the elephant!). I was trained as a chemist. Chemists have, in their laboratories, to handle all sorts of noxious materials. The first rule for chemists is to handle *everything* with care and respect: Don't spill: Don't touch: Don't taste: Don't swallow: Don't breathe: Don't smell: Always handle with care and caution! The second rule is: "Know thine enemy". Certain materials have very special properties; know them and respect them. To me, as a chemist, radioactive materials are just one more noxious material which I have to handle.

In some respects I am happier to deal with radioactive materials than with some non-radioactive materials I can think of. Radioactivity can almost always be put into a form where it stays put and can't leap out at your or explode. Even though one's natural senses don't tell one what is radioactive and what is not, we have instruments of incredible sensitivity which can detect radioactivity in extremely small amounts. Because of this, radioactivity is often easier to handle and live with in the laboratory than many other materials.

If we know our enemies, we can protect ourselves. There is nothing wrong in having to take special precautions to protect ourselves. It is a good thing that we can and do! Let me illustrate:

The photograph of the masked operators on the cover of "Anticipation" has two messages. Masks are very ugly (and what is worse, very uncomfortable). The message is sinister. On the other hand, these workers are prepared for a special job. They know their enemy. In a laboratory where I worked, our operators had to use such masks quite often, not for radioactive material, but for asbestos dust, which

* Director, office of Energy Research and Development, Ottawa, Canada.

in its way is every bit as noxious as anything radioactive. On occasion we hired contract labour from outside to cover pipes with asbestos insulation. Because of the vagaries of the labour and industrial safety codes these workers chose *not* to wear masks – and we couldn't require them to do so! As I saw it, wearing of the masks was a good thing: not a bad one!

Turning now to radioactive waste management. When irradiated fuel is taken out of the reactor we have a very concentrated lump of radioactive material, which must always be isolated from the environment. We must not allow even very small amounts of this activity to enter the air we breathe and the water we drink. We must have assurance of this for a very long time.

Because radioactive materials decay with time the amounts change with time. I have sketched this in the graph in the "Anticipation" article. There is a large amount of *activity* which decays away in some 500 years (the activity due to fission products) and a relatively small amount due to heavy elements like plutonium which persists for a very much longer time, say, 1/4 to 1/2 million years.

To achieve this isolation, the material must be solidified and not be in a gaseous or liquid form which can move around easily. The solid must also be as close to insoluble in water as can be achieved because leakage into the environment through contact with water is the dominant concern. The technical claim can be made that solidification *alone* is enough. One can make blocks of insoluble material and certainly radioactive and bury them in ground water and still be able to drink "safe" water from a well a few hundred metres away.

Following solidification, we propose burial in some old stable rock which has been left unaltered by geologic forces for times which are very much longer than half a million years. Typically rocks are hundreds to thousands of millions years old. Having buried it in an artificial cavity, one can then turn one's back on it. Of course we have to meet the question: What happens if the rock breaks open and water does get at the material? This is already answered by the proposition that the material is sufficiently insoluble that it could be buried in shallow ground without causing harm.

How can we be sure that these proposals are safe? Discussions of safety often have a common, logical form. The consequence of some untoward incident and its probability are given some number. It is then argued that this number is small compared with some other event which we can accept. For waste management, it is difficult even to guess at any numbers. I can quote from the recent Ford Foundation study on this topic which said: "... it appears to be very difficult to postulate realistic failure mechanisms which would imply consequences of catastrophic or even serious proportions to future generations".

Let me share with you some intuitive arguments that I have found which allow me to agree with the Ford Foundation comment.

To move from my elephant to another animal I present another simile – We have to keep a lion in a cage! The hazard of "lion management" is related to how hungry the lion is and how strong the cage is. The hazard of waste management turns in part on a question: How dangerous are radioactive materials? We can imagine a scale from a material so dangerous that the escape of one atom would destroy the whole universe to a material as benign as a packet of cornflakes. There would be a corresponding scale for the security of the cage.

I can give an example of a cage for radioactive materials and a practical illustration of hazards. At a uranium mine in Canada there is a tailings pond beside a highway which is also adjacent to a stream providing drinking water for a number of cottages a mile or so away. The sludge in the pond contains 1000 curies (1 kg.) of radium. The stream is, however, potable and the cottage owners are not at hazard. Make no mistake, it is an unsanitary situation. We are not going to allow it to happen again!

If the uranium and radium had never been mined and had been left 1000 feet below the surface where they had been for perhaps a thousand million years (through many ice ages) they would patently not be a hazard or worry. I can thus say that the feasibility of geologic containment for radioactive materials is demonstrated.

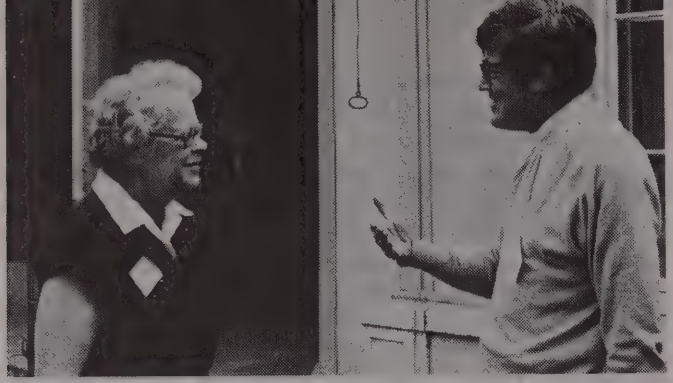
The hazardous material in uranium ore is largely radium. Radium is radioactive in the same way that plutonium is. Because of the different half lives you find that radium/per gramme is about 15 times as noxious as plutonium. If, again, you note that plutonium is much less readily absorbed than radium from water you find that the long term content of noxious material in spent fuel and in uranium ore is about the same. A repository for long lived radioactive waste can thus be reasonably compared to a uranium or body. Thus, I don't feel I have to be *more* concerned about a carefully designed waste repository than an ore body as yet undiscovered. To come back to my analogy, I am showing you a lion and a tiger, one about as hungry as the other, and that an effective cage for the lion exists. It should be good enough for the tiger!

It is, of course, a very different matter for fission products because the amount of activity is so much greater. For me the argument now turns on the expectation that rocks millions of years old are not going to change their form and structure radically in the relatively very short time of 500 years. Here I can describe for you my first impression of a potash mine in Saskatchewan, which could be a model of a repository. A descent 3000 feet into the earth's crust is impressive enough. Inside the salt caverns one is standing with hundreds of feet of salt above and below one, in a layer which runs for tens to hundreds of miles away in all directions. Standing in the mine "it is indeed difficult to think of realistic failure mechnisms which could release significant amounts of radioactivity". To return to my analogy with lions in cages, I have a very hungry lion indeed. However, the cage has been solid for many years and he's only hungry for a day!

I have examined my conscience long and hard over these matters and I can simply state my conviction; radioactive waste management can be done: it is a reasonable technical objective. If properly done the risks are minimal.

I realise that some of you here may not be able to agree. There is an extreme opposite point of view, that radioactive materials are so unpleasant that one can't take even that minimal risk. In respect of nuclear power then, the sends could not ever justify the means.

In examining that point of view I find myself in extreme difficulties in rationalizing almost every other human industrial activity. I have to ask what other things we do which can have large, open ended and unknown consequences. They are legion: Remember the uranium mine with its pile of tailings. In a better operation these are not dumped into lakes but are placed in a pile on the surface. Current regulations require these to be grassed over so that wind and water erosion are minimized. (This is certainly a more relaxed approach than that we are proposing for spent fuel). My intuitive feeling is that such measures are an adequate protection against the dispersal of radium. Be that as it may; tailings piles may also contain significant amounts of arsenic and lead, materials which are not radioactive and persist for ever (for theological time if you like). I just cannot see the logic of an absolute ban on nuclear power because of the

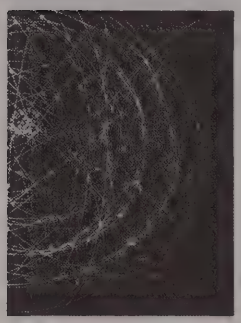


Dr. Ruth Wick, Lutheran Church Offices talking with Dr. Peter Dyne Director, Office of Energy, Research and Development, Ottawa.

need for radioactive waste management if we can countenance any heavy metal mining or refining where we have to disperse irreversibly, vast amounts of toxic materials.

The mining and refining of radioactive materials is only one example of the many things we do which constitute a legacy for future generations. Forests are destroyed, minerals are extracted, toxic heavy metals are extracted and widely dispersed, fossil fuels are burnt and their combustion gases released to the atmosphere. Everywhere the hand of man is vile. In a different vein, a commitment to intensive agriculture is a commitment for all future generations because we now have a whole world of 4 billion and more people utterly dependent on it. We have accepted all these things in the past because we didn't think about them. The radioactive case really does make us think. It is, however, one instance where we can, effectively, minimize environmental effects.

The judgement on nuclear power and hence on uranium mining, has then to be made in the general context of all environmental effects of all human activities. These effects cannot be zero: but how small can we really expect them to be?



DO WE NEED NUCLEAR ENERGY AT ALL?

*Gerald Leach**

Conventional wisdom has it that a country uses more energy as it grows richer. Since governments must assume rising prosperity, their energy forecasts therefore show increasing demands, widening "gaps" for oil and gas, and the need for more nuclear power to fill them. This happens even while everyone is loudly proclaiming the importance of energy conservation.

Two years ago the International Institute for Environment and Development (IIED) Energy Project began to examine this assumption. In a post-1973 era, it seemed likely that some quite moderate technical fixes could decouple growth from rising energy use. Wherever we looked in the energy conservation literature, people were reporting actual or potential fuel savings of around 25 to 50 per cent from the application of anything from free human ingenuity to investments. Many of these inventions paid for themselves within only one or two years even with today's fuel prices. In some instances such as new house and office designs, it was proving cheaper to halve energy consumption than to build conventionally. Even allowing for institutional inertia, why were government forecasts assuming savings over the next 20 years of only 10 to 20 per cent?

Even odder was the way people were forecasting energy demand. The game was to take large sectors, such as housing, industry or public services, lump all their types of energy use together, see how this aggregate rose with income or economic output during the pre-1973 era, and then assume that these links hold good for the next 20 or so years. This gives a hypothetical demand which is then knocked down by some percentage owing to conservation effects. This is how the UK Department of Energy forecasts the sectors just mentioned, which account for 67 per cent of energy and 92 per cent of electricity use.

One oddity is the use of pre-1973 trends, before energy prices soared. Since 1973 many of the links have vanished or gone negative: incomes and output have risen while energy use has stayed level or declined. Why not use these post-1973 trends as the forecasting basis? More fundamental is the assumption that energy use is that simple. In industry, for example, energy is used for many different purposes, each with different opportunities (and constraints) for more effective use. Industries vary enormously in their energy intensity and are likely to grow at different rates. Buildings, in which most energy is consumed, have complex energy interactions which tend to hold down the major use of energy – for heating – as well as obvious limits on heating and lighting levels, however high one's income or economic output.

In short, by its forecasting methods and generally weak assumptions about technical change, might conventional wisdom be greatly overestimating future energy demand – and therefore the need for new energy supplies?

The IIED publishes one answer to this question this week. It is a detailed analysis of the use of different types of energy in different sectors of the economy in the UK. Its main conclusion is that the UK (and by implication other industrial countries) could have a future of prosperous material growth and yet use less energy than it does today. As Figures 1 and 2 show, if the gross domestic product (GDP) roughly trebles in round terms by 2025, our calculations suggest that a series of simple, known technical fixes could keep energy (and electricity) demand more or less constant from here on. If GDP doubles, oil consumption could be roughly halved, coal output could remain constant. Nuclear output could fall steadily from 1990 (when the

* Reprinted from New Scientist, Jan. 11, 1979. Gerald Leach is a member of the staff of the International Institute for Environment and Development and leader of its Energy Project which has recently published *A Low Energy Strategy for the United Kingdom*. (London, 1979).

stations now under construction or planned are built) and primary energy consumption could be down about 7 per cent on today's levels by 2000 and 20 to 25 per cent by 2025.

Obviously this conclusion is only as good as the assumptions that went into it. Thanks to several excellent studies that have appeared only last year, we were able to base our study on a very detailed breakdown of the final use of energy by different fuels, types of appliance and end-use purpose in 1976 which ran to nearly 400 possible categories. For example, the industry scenarios are based on eight separate sectors, each with seven fuels or energy sources including self-generated heat and electricity that provide 13 end-uses including four temperature bands for direct and for indirect process heating. In housing we considered four types (existing and new houses and flats), each with separate components for space and water heating, cooking, lighting, and even categories of electrical appliances.

Basic scenarios

All this may seem like numerical overkill in the face of huge uncertainties, but in our view it is essential for credibility. Every assumption is clearly specified so that others can test, reject, or adapt them using their own prejudices about what is reasonable or plausible. Policy assumptions are absolutely explicit. Equally important, only such a detailed physical model can tease out the large technical opportunities for energy saving that undoubtedly exist and detect some of the many energy reducing interactions and saturation effects that can easily be missed by conventional economically-based methods.

Given this detailed baseline, the scenarios involve projecting all the basic energy-using activities – such as traffic levels or housing temperatures – and their energy intensity, or how much fuel of each kind is used per unit of activity. Simple arithmetic gives the total delivered energy or heat supplied for each fuel, which with further assumptions about the efficiency of the supply industries gives primary energy demand.

To make these projections we deliberately assumed a fairly high growth "business as usual" future. The reasons are not ideological (or wishful thinking) but simply because we wanted to keep the argument focused on energy policies. In fact GDP grows at almost exactly the rates used in the current Department of Energy forecasts, with per capita increases in the "Low" and "High" growth cases of 70 to 90 per cent by 2000 and 98 to 182 per cent by 2025.

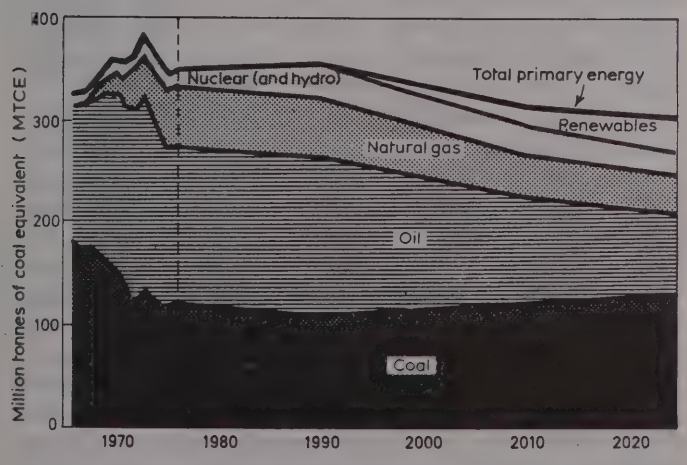


Figure 1 Projections of energy usage to the year 2025 in a "High" demand scenario.

Within this overall framework numerous detailed assumptions are made about improved living standards. For example, average house temperatures rise from an estimated 16°C today to 18°C, which amply provides for 20 to 22°C temperatures in living areas when they are occupied. Most families come to own freezers, dishwashers, clothes dryers, colour TV and other heavy electricity users. Ownership of cars grows rapidly so that 72 to 75 per cent of households in 2000 have at least one car, compared with 58 per cent today. Increase in traffic in the Low case closely follows the official forecasts that are now used for transport and road planning; in the High case it approaches the "maximum possible" projections. Air traffic grows 2·4 to 3 times by 2025. Total industrial production increases by a factor of 1·7 to 2·2, while the heated and lit areas of offices, schools, hospitals, shops and restaurants increase by anything from 30 to 80 per cent.

For energy savings, our assumptions merely involve the introduction at fairly moderate rates of technologies that are already widely used or, in a few cases, are expected from a canvassing of expert opinion to be available by the mid-1980s. All of them are either cost effective now or are being developed because people expect them to be cost effective.

In industry, for example, fuel consumption per pound Sterling of output falls by 22 to 35 per cent, depending on the sector, over 1976-2010. This is an average rate of only 0·6 to 0·9 per cent per year, and in some cases is slower than past trends towards greater energy efficiency. In housing we have assumed it takes 30 years before those of today's dwellings which still exist have loft and cavity wall insulation, where this is possible. Standards in new dwellings are successively tightened until 1990, when heat losses are half those of the 1975 building regulations. Many houses have already been built to these 1990 standards with small or zero cost penalties, using traditional construction methods. With heating equipment, modern "best practice" designs are installed in new dwellings and replace existing stock as this wears out by 2000. Electric and gas heat pumps, which are expected to be in mass production during the early 1980s, are introduced gradually to take 15 per cent of the market by 2000.

Use of energy per unit in the commercial and institutional sector (offices, schools, hospitals, catering, etc) area fell about 20 per cent during 1960-75, while the government's Property Services Agency has achieved average savings of 35 per cent since 1972-73 with financial payback times of well under one year. We have assumed long term savings of 30 to 50 per cent, depending on the type of building and pattern of energy use. For new buildings energy use is 40 to 60 per cent below present averages, following the example of scores of recent designs.

Our assumptions in transport are generally less optimistic than those of the latest Department of Energy forecasts, which assume a 40 per cent drop in the specific fuel consumption of cars and light vans by 2000. Our figures are 34 per cent and 26 per cent with only 10 per cent for heavy lorries. Electric vehicles are introduced only after 2000 and then at modest rates.

Government's role

Some degree of government intervention would certainly be required if the energy conservation we envisage were to happen. Howeve, one must remember that massive intervention – and subsidies – are typical on the supply side. In particular, we have assumed that government sets energy consumption targets for new buildings of all kinds, for cars

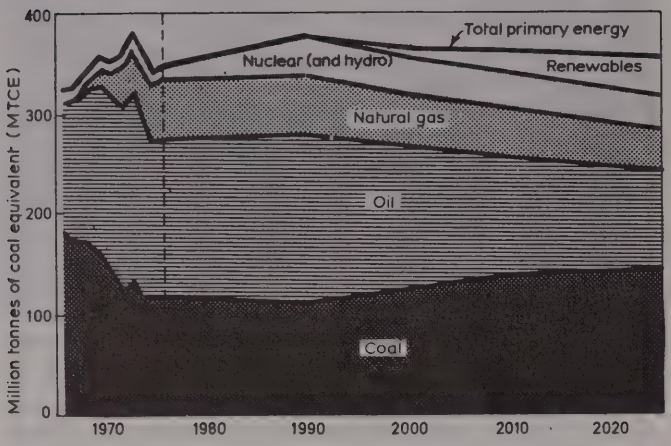


Figure 2 Projections of energy usage to the year 2025 in a "low" demand scenario.

and light vans, and for cookers and major electrical white goods. In all these important categories energy savings of about 50 per cent are technically possible – and with the possible exception of road vehicles – at very low cost. But government-led industrial agreement may be needed to secure them. A second policy assumption is that determined efforts are made to provide consumers of all kinds with information about available "best practice" technologies and techniques. Government and professional bodies are rapidly stepping up their efforts on these lines. All that we have done is to couple this growing political determination with a range of technical opportunities and likely growths in energy-using activities, and projected the consequences.

The consequences for energy supply are rather startling. Figures 1 and 2 show that primary energy demand in 2000 is only 330 to 361 million tonnes coal equivalent (mtce) compared with the current Department of Energy forecast of 460 to 570 mtce. Furthermore, energy use declines after 2000 – contrary to most expectations. This is due to a slowing growth in some key areas such as the number of households and traffic levels; the long lead times for some major energy saving technologies; and our assumption that renewable energy sources (such as the Sun, wind and waves) and combined heat and power (CHP) schemes do not begin to take off until after 2000. Our assumptions for the contributions in 2000 from renewables and CHP are well below those of the present Department of Energy forecasts. This is not because we think these technologies are unimportant, but merely because we wanted to highlight the enormous savings obtainable from currently available and quite conventional technologies.

Because of this low energy growth, the UK could be almost self-sufficient in oil and gas until 2025. The only significant "gap" occurs for oil if one takes the present central estimate of North Sea reserves. The shortfall opens up to an annual 60 to 80 mtce by 2025, or roughly half recent levels of oil imports. Coal liquefaction, imported biomass (wood, etc.) fuels from the tropical "sun belt", and some imported crude oil could easily plug this hole, which virtually disappears if one uses the upper range of reserve estimates. Coal production rises by 2025 to only 128 to 148 million tonnes a year, or well under the present *Plan for Coal* target of 170 million tonnes by 2000. There is thus plenty of slack.

But the most remarkable policy implications are for electricity and nuclear supplies. We have not been "anti-electric": there are more electrical devices and cookers in the home, more electrification in industry, more electric trains, and a sizeable fleet of electric road vehicles. However, due to greater efficiencies, demand does not grow over the long-term. Consequently, only 26 to 30 gigawatts (GW) of generating capacity need be built (mostly to replace retired plant) between now and 2000, compared with 83 GW in the present Department of Energy forecasts. The savings in capital investment would be of the order of £25-30.000 million, or well over £1000 million a year.

Nuclear power assumes an almost peripheral role and could easily be abandoned if desired. We have in fact kept the nuclear option open but at a low tick-over level. From 1976 to 2000 only 4·5-6·5 GW of nuclear capacity is built apart from plant now under construction and the two advanced gas-cooled reactors planned for Thorness and Heysham. This compares with 30 GW in the Department of Energy's reference forecast. If more were built there would either be a huge surplus of generating capacity, or coal production would have to be reduced to politically implausible levels. The fast breeder reactor is simply not needed for energy supply and could be shelved indefinitely.

The main point of these scenarios is not to say that the future will be like this but to show that it *could* be. An energy future of low risk is possible, with only moderate change. If other countries that currently use a lot of energy followed a similar low energy path, the reduction of international tensions and the drain on world fuel resources could have remarkable effects on global development, equity and self-confidence.

Curiously, five years after the 1973-74 fuel "crisis", such a future now seems increasingly likely. In almost every country energy forecasts are falling as new energy-conscious policies and economies emerge. In Britain the Department of Energy's forecasts for 1990 have fallen at such a rate since 1975 that by 1980 they should be predicting zero energy growth. Actual energy consumption in 1978 is almost certain to be lower than in 1970 despite a rise in GDP of at least 10 per cent. In the US six years ago the extreme range of forecasts for 2000 was 124 to 190 quads (10^{15} British Thermal Units). In 1978 the respectable range was 63 (for 2010) to 124 quads: yesterday's ultra-low heresy has become today's record high. Similar sweeping changes in perceptions of the energy future are occurring in Europe.

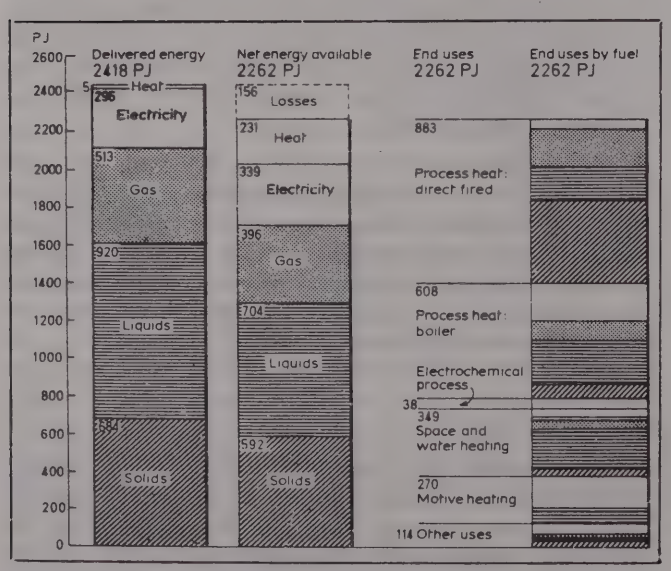
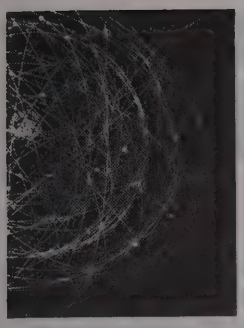


Figure 3 Breakdown of the total use of different forms of energy in UK industry at present.



INTERNATIONAL DEVELOPMENT AND CONTROL OF NUCLEAR TECHNOLOGY

*Sigvard Eklund**

INTRODUCTION

When in 1974 Paul Abrecht and John Francis came to the International Atomic Energy Agency and told my staff of the interest of the World Council of Churches in nuclear power programmes, I must confess that I was somewhat surprised. The interest that church groups could have in nuclear technology and the contribution that they could make to what is loosely called "the nuclear debate" was not at all clear to me. In the years that have passed since then, with the Sigtuna Hearing, the publication of *Facing up to Nuclear Power,* the formation of the WCC Energy Advisory Group, the active participation of the WCC in the IAEA's Salzburg Conference on Nuclear Power and its Fuel Cycle, and this second WCC consultation, a two-way learning process has taken place. The WCC has learned a lot about nuclear power. The IAEA has learned a lot about the WCC's concerns in relation to nuclear power. We in the IAEA have also appreciated the seriousness and sense of responsibility with which the WCC has undertaken its studies. There has been a continuous effort, on your part, to maintain objectivity in a debate which has, unfortunately, become highly polarized.

You have discussed this week the positions taken by various church groups and the main issues of concern to you have emerged. I would like to take this opportunity to share with you my views on some of these issues, which I will do briefly to allow as much time as possible for discussion.

The first basic question is, do we need nuclear power and if so, for how long? My short answer to that is yes, certainly over the next three decades at least; and as a main source of energy probably for centuries. Any shortage of energy, or a sharp rise in its price, would affect poor countries and poor people hardest.

My assumption here is that even to maintain our present standard of living, which, of course, for some sectors of society is not at an adequate level now, we will need more energy. Additional energy will be required because of world population growth (now 4 billion and projected to be 6 billion by 2000 with most of the increase occurring in developing countries); because of the increasingly poorer quality of the raw materials available to us and therefore requiring more energy to extract them; and last but not least, because of the necessity to narrow the gap between the developed and the developing countries.

Fossil fuels are finite and we certainly have reached the end of the fossil fuel age. The present consumption of about 6 billion tons of oil equivalent will increase to about twice to three times this level by the year 2000 – even with maximum efforts at conserving energy. Coal is more abundant, but its exploitation is limited by social and environmental concerns. It is no longer easy to find a labour force willing to undertake the hardships and risks of mining. Further, these irreplaceable resources, too valuable to be burned up, are very unevenly distributed in the world; 70% of the world's oil reserves being in the Middle East and 80% of the coal reserves in the US, the USSR and China. The so-called alternative energy sources – wind, tidal, geothermal and solar – would be more appropriately called complementary, as they can only provide marginal additions to the electric energy budget in the next three decades. I am speaking about the production of electricity; it is to be hoped that solar energy will, in a rather short time and in selected countries, provide substantial amounts of low-grade heat.

Many critics of nuclear power talk about solar energy as if it were an alternative to nuclear. This is simply not true. One must be realistic and recall that even after expenditures of tens of billions of dollars and more than 20 years after the completion of the first nuclear power plant prototype nuclear power still has not reached 10% of global electricity production. To bring new energy sources, for example solar energy, to this stage will require not only research and development expenditures but also considerable *time.*

We have heard that energy conservation and a radical change in life styles might change the situation and make nuclear power unnecessary. I am the first person to advocate a more efficient use of energy, especially in countries that "over-consume" energy. In fact, energy conservation will be essential no matter what scenario is adopted. Nevertheless, it is unrealistic to expect any society to adopt a lower standard of living and to expect this of groups and countries living at a subsistence level is not defensible.

Another question which has been raised is the economics of nuclear power. Capital costs of nuclear power plants have increased roughly fivefold over the last ten years expressed in current US dollars. Removing the effect of general inflation from our comparison, we can see that the unit capital costs of coal- and oil-fired stations have been multiplied by almost exactly the same factors over this ten-year period. As far as capital costs are concerned, the competitive position of nuclear power has therefore hardly been altered.

Why then has there been a slump in orders for nuclear power plants over the last few years? I believe this is because of a chain of events – the world-wide economic recession which caused decreased orders for all types of electric power plants, existing overcapacity in certain countries, lengthened prelicensing and construction periods and safety and environmental considerations brought forward often forcefully by nuclear opposition groups. These impacts combined with the usual short-term planning of politicians, bound by the next election term, have brought about serious difficulties for the longer term decision-makers in the electric power sector.

As a result, delays, cancellations and cost overruns have occurred which have in turn been used as new arguments against nuclear power.

The main areas in which uncertainties have arisen include all those which are being discussed here this week; that is, safety, waste disposal, and the proliferation of nuclear weapons.

---

* *Director General, International Atomic Energy Agency*

The Debate About Safety

Regarding questions of safety, while I credit the environmentalist movement with helping to raise the safety consciousness of the industrial community, the demands for additional, and sometimes extraordinary, safety measures have now reached the point of requiring steps that are costly, time-consuming and redundant. The associated legal questions have made nuclear energy a lawyer's paradise. The industry has been requested for instance, to *prove* that no serious accident can occur. No other industry has ever been asked to do this and, indeed, no other industrial technology has ever been the subject of such comprehensive analyses of its environmental effects.

However, the probability of nuclear accident is so small that it is difficult to grasp its real significance. During the 20 years of experience with civilian nuclear power plants, which represent 1,500 years of reactor operation, there has been not a single fatal accident caused by the nuclear part of the plant. The risk is in any case much lower than many risks we daily accept in our society.

In the area of radioactive waste, there is a trend now to require "proof" that the waste will be safely disposed of. My own conviction is similar to that of an outstanding British authority who classified the disposal of radioactive waste as a non-problem. One must stop and think that the nuclear-weapons States are already now storing much more radioactive material (from weapons programmes) than will be produced by all the civilian reactors of the world until the end of this century. There are technical solutions for radioactive waste storage which will be adequate when, in a few decades time, the amount of radioactive waste from civilian plants becomes substantial.

We hear much about the "long-term and irreversible" effects of radioactivity. I can only comment that the radioactivity in nuclear wastes will decrease with the passage of time and that these wastes will be stored underground in isolation from man's environment. Combustion gases (particularly CO_2) from fossil-fuelled plants actually accumulate in the atmosphere and we have no idea what the long-term effects might be. We have a responsibility to think very carefully about our legacy to future generations. A Soviet scientist said that he would prefer leaving nuclear wastes to the care of future generations to leaving them an earth with no coal, gas or oil.

On both questions of nuclear power plant safety and radioactive waste management the IAEA has a regulatory responsibility about which I would like to say a few words.

One of the most important programmes of the Agency over the past several years has been to establish internationally acceptable safety codes, standards and guides that will not only help to ensure the safe design, siting, construction and operation of nuclear plants but will also we hope give the necessary assurance to the public. A truly international authority which is independent of both governments and nuclear industry, but has the necessary technical competence to judge the adequacy of safety measures could carry more weight in the public mind than the efforts of national nuclear regulatory bodies. Adherence to these international safety codes should be a basic requirement for all nuclear power projects, thus assuring that the future spread of nuclear power plants will not bring about greater risks to the public. I might add that in working out these safety standards, we consult with and receive the endorsement of the World Health Organization and the United Nations Environment Programme, not to speak of the independent assessments of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), which evaluates the global releases of radioactivity, and the recommendations of the International Commission for Radiological Protection (ICRP) concerning radiation dose limits for workers and the general public. This is a rather unique situation whereby 5 international bodies examine independently from each other the environmental aspects of the nuclear industry. Compared with this effort, work with regard to the consequences of fossil-fuel uses is still in the early development stage.

Regarding waste disposal, I would not be astonished if in the near future offers will be received from countries which have on their territories deserts or salt-dome areas, to accept, perhaps under international auspices, radioactive wastes or used fuel elements from other countries. This is an area for future international cooperation, as the volume of wastes will be relatively small and a few waste disposal sites could accommodate global needs. The IAEA has sponsored several scientific consultations on this subject and is ready to play an active role as soon as policy decisions are taken by our Member States.

The Proliferation Issue

In the past twelve months the question of non-proliferation of nuclear weapons has attracted more governmental and public attention than ever before.

We in the IAEA have been working with the problems of proliferation since the very start. In fact, this problem is perhaps the major *raison d'être* of the organization. It is one of the pillars of IAEA's activities "to ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose" (Statute, Article II). I myself in the early 1960's in annual statements to the General Assembly of the United Nations, tried to draw attention with scant success at the time, to the growing amounts of plutonium which were bound to be produced by the expansion of nuclear technology and I stressed the consequent need for truly effective and universal safeguards. It is not, therefore, for us to belittle in any way the risk of proliferation but we must try to see it in its true perspective.

The history of the last thirty years has demonstrated that even the most strenuous efforts at control will not prevent the slow but steady spread of the technology needed to produce highly enriched uranium or separate plutonium. Knowledge once given away cannot be retracted. I see little prospect that the next thirty years will show us the way of creating technological or legal barriers against dissemination of industrial technologies – and I don't think this is what we truly want. I repeat what I have said before:

> I don't believe that a policy of denial could be either realistic or effective. What is, however, necessary now is to strengthen the existing international framework aiming at the non-proliferation of nuclear weapons. I am sure that in this context the IAEA can make a major contribution to diminishing the political uncertainty by applying safeguards, what is called full-scope safeguards, effectively and universally in the non-nuclear-weapon States, or be instrumental in other non-proliferation measures complementary to safeguards. Whether this universality of safeguards can be achieved, or other measures agreed upon, is up to the statesmen of the world. It is not a matter within our power in Vienna.

Since 1974, there has been a growing apprehension that even effective international safeguards may not be adequate to prevent a country producing nuclear explosive material if it already has within its reach the means to do so. Debate has focused on the question of detection times or the "timely warning" needed to give diplomacy enough

time to act upon the would-be diverter after he has begun the process of diversion but before the explosion takes place.

Until now it has been the IAEA's view that the chief political value of safeguards was to give other countries the continuing assurance that the safeguards country was not diverting – in order to remove this particular uncertainty – rather than to give time for international diplomatic action after a decision to divert has already been made. It still seems to us in Vienna that the continuous assurance of non-diversion rather than the last-minute prevention of an intended diversion must remain the main objective of safeguards. The objective of safeguards is the timely detection of the diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons.

We would all agree that the world would be a better place if the production of enriched uranium and plutonium were concentrated in as few localities as possible and were preferably undertaken in large, truly commercial plants operated under international or regional auspices. It is also in all our interests that the political uncertainties that have beset the supply of nuclear fuel and particularly enriched fuel in recent years be diminished.

The Agency's system of inspection and verification covers all nuclear activities in all non-nuclear-weapon States except five – Egypt, India, Israel, South Africa and Spain. The system operates either under the safeguards system provided for by the Agency's Statute, which has been operational since the early 1960's, or under the Non-Proliferation Treaty (NPT) which came into force in March 1970. The earlier safeguards system covers specific installations, material and transfers of technology. These safeguards are being applied, for example, to the facilities provided to Brazil by the Federal Republic of Germany. Since the advent of the NPT, the 101 non-nuclear-weapon States party to it have accepted IAEA safeguards on *all* nuclear activities on their territories.

This is the first time in the history of mankind that an international inspection system has been accepted. Since its operation a wealth of experience has been accumulated; and, even though there is always room for improvement, the system works well. We hope that in the future it may serve as a model for similar undertakings in the realm of disarmament. This has been the success of NPT. To speak of any "failure" of the Treaty in this respect is incorrect. If you ask yourself the question, "How effective has the NPT been in preventing proliferation in those countries that have ratified it?" – then the short answer is: one hundred per cent. No party to it has breached the Treaty.

The safeguards system is built upon legal agreements with States, approved by the Agency's Board of Governors (34 Member States), that lay out the responsibilities of States to provide the Agency with continuous accounts and reports on the quantities and location of special fissionable material in their nuclear installations. Through these agreements, the Agency's team of international inspectors is given access to these installations to check that the written reports coincide with the actual physical inventories. They also apply seals and install automatic monitoring instruments. In some types of facilities an almost constant inspection effort is required. Nuclear power stations themselves present fewer problems from the non-proliferation point of view, and are not considered as "sensitive" facilities, as you know.

While I welcome the newly-awakened concern about the proliferation of nuclear weapons, I am rather astonished that not more is said about the wide-spread storage of nuclear weapons in certain regions of the world and notably in Europe. Have we become oblivious to the 15 or 20,000 nuclear warheads poised for instant release on the continent of Europe and to the passage of more than 150 military nuclear submarines (that is at least 150 reactors) around our coasts and through our narrow seas? These ships have, among others, the task of destroying each other without any consideration of the releases of radioactivity that would result. I understand that this consultation has devoted some attention to this problem, and I welcome this.

We hear a lot about the danger of terrorists stealing material from civilian programmes, but very little about the danger of them taking a ready-made bomb from the huge stockpiles that exist. These military installations present, to my view, the far greater risk to mankind. They will still be around whether or not countries take up the peaceful nuclear power option. Perhaps it is out of a sense of frustration that the public has nothing to say about the nuclear arsenals in the world that they, in some sectors, are ready to turn their wrath on a peaceful application of the same name. I think it is an unfortunate confusion of two very different types of activities. Nuclear power does *not* equal nuclear weapons, and to reduce the latter by attacking the former is equivalent to grounding Jumbo jets because the technology is related to that of the Cruise missiles.

At the initiative of the US Government, an International Nuclear Fuel Cycle Evalutation (INFCE) was launched last autumn, meant to cover *all* the aspects of the industrial nuclear fuel cycle.

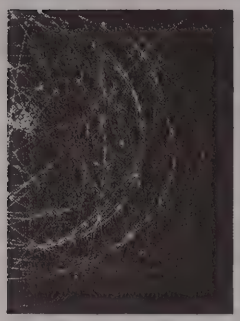
I believe that one of the outcomes of INFCE, which should complete its work by the end of 1979, will be a call for increasingly close international cooperation on the problems of reprocessing, the management of spent fuel and plutonium storage. The exercise has already shown the interdependence of countries with nuclear programmes. New forms of international collaboration are required and, I hope, will be forthcoming. I am thinking here, for instance, of regional fuel cycle centres, which would limit the number of plants, making them more economical, more efficient, easier to safeguard and safer to operate, while giving also a sense of mutual responsibility.

As a former scientist I tend to judge such questions as I have raised taking into account technical considerations. However, I cannot accept that mankind, having used its ingenuity to develop nuclear energy as a source of electric power, will not be able to devise ways to prevent its misuse. Mankind has demonstrated that it is possible to turn the nuclear "sword" into a "ploughshare", but suddenly has begun to doubt itself.

Modern society is providing marvellous opportunities for an evergrowing population. What I have in mind is our access to food, medical care, and communications systems unthinkable a few decades ago. This represents achievements based upon an unrecognized delicate infrastructure in its turn based upon scientific and technical developments. The search for truth is the essence of science. I am very much disturbed by the growing tendency to mistrust the advice given by outstanding specialists. Instead, one often finds media, the public and even governments preferring to listen to self-appointed "experts" from other fields or, worse, from no field at all. The real experts are disqualified by their own expertise, whereas the non-experts are to be believed, because they are considered to be objective. If society is going to fulfil its growing responsibilities, the trend I have referred to must be disrupted, and governments return to the decision-making process which up until now has been so successful.

We can survive *only* through the best possible use of science and technology. I hesitate to use the world "moral" when discussing these issues, but what position will be taken towards the energy-hungry and resource-poor developing countries who are asking for access to this new technology and who cannot afford the luxury of "no-growth" policies? What "just and sustainable" society can defend a policy of denial?

In closing, I would like to quote a recent statement by Cardinal König, Archbishop of Vienna. "Scientists and technologists must realize how much the achievement of good, ethically acceptable solutions depends on their work and their accomplishments. And the politicians must be resolute in taking their decisions with the future good of mankind in mind."



TWO STATEMENTS FROM CHURCHES ON THE NUCLEAR ENERGY FROM FRANCE AND ITALY

A. A report from the Council of the Protestant Church Federation of France, April 6, 1978

Urged by people of many points of view to reflect on the problems of nuclear energy, the Council of the Protestant Federation of France, in September 1977, requested its Social, Economic and International Commission to study these questions.

Their importance is in fact such that they cannot leave the churches indifferent. The world in which we live and of which we are only the stewards is destined for a renewal which will make of it a world of light. This renewal is assured because it is the work of God alone, the Master of History, as he manifested himself in Jesus Christ. Those who in faith place themselves before this perspective, are logically directed in their personal life and also in the positions which they take in public debates, to reject the absurd, that is, the deliberate decision which leads clearly to consequences incompatible with the hoped for future. And the problem of nuclear energy is clearly one of those which risks leading to absurd decisions.

Because of the complexity of the problem the Commission made wide use of outside competence and expertise and hence invited different persons whose qualifications and responsibility were particularly evident and whose orientations were diverse. These personalities agreed in their personal capacity to reply to a series of questions prepared in advance.

Informed by these responses, sometimes contradictory, the Commission concluded that it was completely impossible for it to elaborate a definitive opinion which could become the position of the Protestant Federation on such a complex subject. It has, on the other hand, noted a very large measure of agreement among its members on the nature of the questions that are posed by the development of nuclear energy. Far from closing the debate these questions must, on the contrary, reopen it and perhaps clarify it.

The Council of the Federation has received them as such and has decided to publish them under its own responsibility.

I. The Choice of Society in the Nuclear Era

It is appropriate first of all to recall that we are already in the nuclear era. Developed thanks to the fundamental research of physicists before 1939, its moment of birth dates from the explosion of the bombs of Hiroshima and Nagasaki. For thirty years the world has lived under the equilibrium of the nuclear terror, which in particular has assured the equal balance between the great powers, the absence of war between the rich countries and their economic development; but also the exportation of their conflicts and of their rivalries to the poorest part of the world. At the same time, civilian research developed, permitting the installation of energy sources based on nuclear reaction and which today are already operating in a number of countries. Let us remember in this regard that France was in 1976, relative to its population, only very modestly equipped in nuclear energy, being far behind countries like Sweden, Switzerland, the Federal Republic of Germany, and the U.K., not to mention the United States.[1]

This brief reminder shows the overlapping of scientific, technological and military questions, of which nuclear energy provides a striking but not unique example. It would be naive to isolate the nuclear problem in our society, and the Commission frequently noted that the same questions could be posed in relation to other areas of technical development.

Nevertheless, the nuclear reality is symbolic in many respects and the diverse manifestations which it has produced all around the world must be taken very seriously, both for the questions that they pose and also for those of which they are only the sign. Since they are questions related to the future of humanity and of society, they are of direct concern to the churches.

We shall raise those which appear the most important.

II. Science, Technology, Economy and World Equilibrium

The discovery of nuclear energy by the transformation of matter into energy is undeniably a feat of human intelligence. The technical realization of this discovery has necessitated considerable work and, in general, one is struck by the seriousness of all those who contributed to it.

1. The capacities in megawatt-electric of the nuclear power stations functioning in 1975 are for France, Sweden, Switzerland, respectively 3026, 2682 and 1052. The French nuclear programme foresees in 1980 a capacity of 20.000 MGE, that is to say, per capita, about double of that which is installed in Switzerland today.

On the other hand, the motivations leading to the accelerated development of nuclear energy, as for example in the French programme, deserve to be examined more closely.

These motivations are founded on the forecast demand for energy in the next twenty years, and the necessity of limiting our imports of petroleum, a constantly increasing burden on our commercial stability.

While recognizing that a public service like the Electricité de France cannot allow itself to run the risk of electricity cuts which would be the consequence of a failure to take decisions in time, the Commission asked several questions. Does not this forecast of energy demand reflect an apparently widespread ideology according to which happiness is the end result of continued growth?

Can the consumption of energy be isolated from consumption in general? Are there not enormous wastes in our rich societies, wastes all the more inadmissible since alongside these affluent countries which are defending their privileges, are others which are sinking in misery and famine? Must we admit, without discussion, the primacy of a certain type of economic development especially when this sanctions, in part, the egoism of the affluent countries in accumulating the great bulk of wealth and thus increases world injustice?

The churches cannot escape these questions.

III. Democracy – Technocracy

On many occasions the Commission has had the feeling that fundamental choices were made without a true democratic debate. Many of our guests tried to refute this impression by indicating that governmental choices had been the object of Parliamentary debates, and that the nuclear question had been much more widely discussed than many other equally important questions.

We cannot deny certainly that a democratic debate had taken place according to traditional forms. But there are many who have the feeling of having been left out of the debate, which poses a grave problem for society: on such a technically difficult question, can the responsibility for the choices be entrusted to others than those who have the knowledge and competence? Technocracy is a real challenge to democracy and this is not true only of the nuclear debate. It is urgent for our societies to reflect on the ways by which mankind can make decisions without becoming the slaves of economic or technical imperatives as defined by groups of experts. This is all the more important insofar as these experts are at the heart of situations where there is a considerable play of interests, and competence is then allied to power. The Commission set out the problem but, there also, does not have a solution.

IV. Uncertainties and Risks – Dangers – Security

All human activity involves a certain number of risks. The evaluation *a priori* of these risks is very difficult. What appears to be true of nuclear energy is the irreversible character of the choice to use it. A technical discussion on oil, coal, hydro-power, does not arouse the people; nevertheless each of these sources of energy involves very real risks and accidents have often taken place. The choice of nuclear energy involves in an irreversible manner the future generations. The Commission has noted also that on several specific points the experts are not always of the same opinion, which increases uncertainty and nourishes anxiety.

It appears clear that the measures of security taken at the level of nuclear reactors, in the French programme have been carefully studied. They probably exceed in severity and in costs anything previously demanded of French industry. Nevertheless, these measures have been applied up to the present only on prototypes and have not been subjected to the test either of time, or of application on a sufficiently large scale, at least so far as the French reactors are concerned.

The fact that the control of the security is entirely in the hands of governmental bodies is also a cause for concern. Whatever may be the traditions of independence of civil servants who exercise key responsibilities, these services are nevertheless exposed to risks of being submitted in certain cases to unbearable pressures – for example in the case where the contracts for reprocessing of waste that France has signed with foreign countries would have to be fulfilled even though the security of the reprocessing plants were not completely guaranteed. While being very conscious of the fact that the technical difficulties of the problems posed demand considerable measures of control, and the intervention of technicians fully aware of the present technical evolution, we think that it would be necessary to introduce the procedures of control authorities independent of political and economic powers. These authorities would gather the opinion of organizations representative of the workers of the nuclear plants, and of the plants for reprocessing. This is the only way to avoid the doubt which preoccupies those who have the feeling that certain problems are being hidden from them, in spite of the flow of information on nuclear issues. It is hard to see, in fact, how those who press for the acceleration of the nuclear programme can appear entirely objective in the debate, and this leads to a certain confusion of opinion.

Beyond the security of the installations themselves, two points remain very troubling: the elimination of wastes and nuclear proliferation.

It is on the problem of waste that we have discovered the greatest divergences among those we questioned. For some, the problem did not even arise, for others it appears far from resolved.

We are in entire agreement with the position of the World Council of Churches who have recently published a long statement on the problems of nuclear energy indicating in particular: "As long as technologically satisfactory solutions to the high level waste disposal problem have not been demonstrated the idea of rapidly expanding nuclear power production is bound to strike much of the public as highly questionable, given the irreversible character of the risk."

In the short run, proliferation is the most important risk of the expansion of nuclear energy, and in particular that of plutonium. It appeared clear to the Commission that the difference between the civil atom and the military atom was artificial. The risks of atomic war will certainly be increased, especially by the sale to foreign countries of nuclear techniques or equipment.

Finally, and especially, there is a fear in our countries, where liberties are already often threatened (by use of computer information), of the growing surveillance of the populations and the installation of repressive measures, justified by these risks but possibly leading to a police regime. Is not the excess of certain police reactions a sign of this danger?

V. The French Nuclear Programme

France has been engaged since 1973 in a very ambitious programme. While similar programmes in other countries have been seriously reduced, this is not the case in France, although important delays in its realization may now be foreseeable. In contrast to those of other countries the French programme is complete since it includes the enrichment of uranium in order to become independent of the

United States, the reprocessing of irradiated fuel, extraction of plutonium and the branching out into breeder reactors.

After hearing very detailed exposés on this programme, the Commission has noted three weak points:

a) The acceleration of the programme

The abandonment of the French plan for graphite-gas reactors in favour of the American pressurized water reactors has, as a consequence, the beginning of a very vast programme which has not passed through the stage of prototypes. All the French nuclear plants will be of the same type, very many are under construction and none have really operated a sufficiently long time. What would happen to the programme if important failures were to show up after some years of operation?

b) Reprocessing of irradiated fuels

If the programme is carried out, the reprocessing capacities now planned will be insufficient. It seems so us that this is by far the weakest link in the chain of the French programme. No reprocessing plant and in particular that of la Hague, has really functioned on an industrial scale. Furthermore, France has undertaken to reprocess the irradiated fuels coming from other countries (Japan, Federal Republic of Germany and Austria). It is certainly on this point that objective and representative information is indispensable.

c) Breeder reactor

This technique appears extremely tempting because of the economy of raw materials which it makes possible. With the Super-Phénix (Creys-Malville), France has engaged in a very ambitious programme largely in advance of the rest of the world. The Commission was not able to pronounce on the dangers of this development because if the risks are certainly greater (plutonium, sodium), it also appears that considerable precautions have been taken.

In any case, the Commission believes that it will be necessary to have sufficient experience with the breeder reactor presently under construction before engaging in any other programme of reactors of this type.

* * *

In a more general way it seems impossible to stop everything which is already in process, yet it is legitimate to ask if the industrial gamble taken by France is not too risky. A more moderate rate of growth would have to be adopted, one which would make it possible to draw all the necessary conclusions with regard to security, impact on the environment and the real cost, and this by methods involving the active participation of authorities independent of those in power. Today we are rather at the stage of projections. It would be desirable at the same time to develop considerably the economies of energy and to think of the future stage since all agree that nuclear fission is only one stage towards the only really unlimited energy in the human time scale, i.e. solar energy. That is what we consider as a moratorium.

But all this demands a political will and a large national agreement in order to come out of our self-contained egoism. The churches must be places where these questions are posed. They must approach the questions with lucidity and with the concern to avoid that our country engages in absurd undertakings. That is why the Commission believes it is necessary to underline three facts:

- In view of the difficulties and the questions which its execution arouses, the nuclear programme cannot proceed on the scale initially foreseen within the time limit fixed. On the other hand this programme will not suffice by itself to resolve the oil crisis. We must admit that this is likely to remain a critical question for numbers of years, placing France and the Western countries in a situation which is for the moment without a solution.
- We cannot escape the absolute necessity of controlling the growth of the consumption of energy and of reducing it much more than the government judges possible today. But the control of the consumption of energy presumes a complete change in the methods by which economic policy is conceived and carried out. It is easy to say that this change necessitates the setting up of a planning mechanism much more rigorous and of international scope. In fact it is a question of profound mutation, implying in particular the transformation of our relations with the Third World.
- Under these conditions it will be necessary to manage without incurring great disorder an energy economy in which there will be a lack of energy-producing equipment. It is likely therefore that we will not be able to escape an economy of rationing, with measures similar to those of a war economy.

To summarize, the absurd which we must refuse in the expectation of the world of light which is promised us, presents itself thus in two directions: it is first of all the fact that the control procedures are not adapted to the extent of the risks which will be incurred, if the programme is carried out regardless of the costs; but it is also the dramatic insufficiency of the energy-producing plant if some nuclear programme is not carried out and if nothing is done to control sufficiently the growth of energy demand.

The Commission believes that a reasonable solution can and must be sought in the narrow way between these two perils: we can expect that through the participation of authorities independent of those in power in the control procedures, industrial risks unacceptable for the future can be avoided – but the programme will only be carried out with a delay (a delay which is already apparent); we can also expect that through a careful programme of measures extending to rationing (a rationing clearly defined and set up in advance) but which should naturally include other rigorous measures determined by the choice of the society, unacceptable disorders which would result from the lack of energy sources would be avoided.

B. From the Waldensian Church of Italy

In 1977 the Synod of the Waldensian Church of Italy appointed a commission on the nuclear problem which, this year, presented a report. The following statement was approved by a large majority.

The Waldensian Church Synod and the Methodist Conference have studied the report of the commission on the question of nuclear energy. *They recognise* that the basic choices on sources of energy (an important question in modern industrial society) are based on decisions delegated by those in power, and not on the collective will of the people. *In the conviction* that discussion on the energy problem should be backed up by greater knowledge, and not marred by preconceived or erroneous ideas, *they recommend:*

That churches and individual believers respond, in their duties as Christian witnesses, with humility and clear thinking, trying by means of:

a) the widest possible diffusion of technical and scientific knowledge (with verification of the various sources of information) about energy available from present sources;

b) so informing themselves that in public discussions about the need to resort to nuclear fission for producing electric energy, about which there are such various opinions, they can help to overcome the present acrimonious taking of sides between those for and those against the building of nuclear power stations. This taking of sides does not help democratic control to develop, but only risks the elimination of the contribution of minority groups;

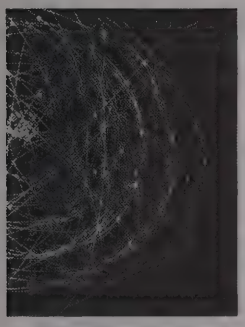
c) putting ourselves on guard against any change of policy towards the transforming of fissionable material into explosives; which means, in practical terms, the strengthening of international surveillance;

d) a realistic analysis of the energy potential of sources other than nuclear fission, and their relationship also to present ecology;

e) a survey of the political implications of State control over sources of energy;

f) the awakening of public opinion on the urgent need to conserve energy and to ensure a just and responsible distribution according to all people's needs.

This complex problem must be faced within the framework of the Divine Law (Genesis), to exercise power over nature for the benefit and not the destruction of both humanity and nature, and not against either, which also recognises the limits of human action.



TWO COMMENTS ON THE HARRISBURG REACTOR ACCIDENT

*From Church groups**

A STATEMENT ON THE THREE MILE ISLAND NUCLEAR ACCIDENT

*From the faculty of Lancaster Theological Seminar**
(Excepts)

On March 28, 1979, and the days following we faced and narrowly escaped disaster at Three Mile Island (TMI). We wish to share our response to TMI and to the continuing crisis of potential nuclear disaster....The following parts of this paper provide a point of departure for our theological reflection and public action.

A. THEOLOGICAL CONTEXT

"The earth is the Lord's and the fullness thereof,
The world and those who dwell therein." Ps. 24:1

To be human is to be part of a complex, interdependent ecological system, marvelously balanced to sustain life. To be human is also to be called to bear unique responsibility for this magnificent, finely-tuned creation called "earth." We humans have utilized the dominion entrusted to us to construct a second environment on the base of the first – a highly technological worldwide society which is just as intricately interrelated as the natural environment itself. Thus humankind has, by God's design, become co-creator of a world intended to be a community of justice, liberty and peace. We are called to become, as Vatican II puts it, "artisans of a new humanity."

Together with the responsibility of co-creatorship, however, goes the freedom and power not only to create but to destroy. Our stewardship can be misused to pollute the earth, exploit its abundance for lesser ends, enslave its people, or even to obliterate it as a habitable planet. Human creativity has produced economic and social structures which carry forward the divine intent in creation; it has also developed structures which poison, oppress or otherwise diminish life. These products of our human creativity have a way of taking on a life of their own, and even of becoming structures of evil: "principalities and powers" in St. Paul's terms. Sometimes it is not easy to identify the positive and negative values of these self-perpetuating systems; often a social structure which once appeared good turns out to be destructive because of unforeseen consequences. When this happens we, as part of the Body of Christ, are called to participate in His work of "disarming the principalities and powers." (Col. 2:15)

We believe that although nuclear energy is a part of God's good creation, it has been developed in ways which have become destructive in our time. The accident at Three Mile Island highlights these harmful aspects of nuclear power in a dramatic way that summons the Church to speak out.

---

* *Lancaster Seminary, in Lancaster Pennsylvania, is a United Church of Christ Seminary with 16 faculty. Three Mile Island lies on the boundary between Lancaster and Dauphin Counties (Harrisburg is the county seat of Dauphin County and Lancaster the county seat of Lancaster County). Lancaster City was not scheduled to be evacuated during the crisis.*

B. PROBLEMS INHERENT IN THE PRESENT DEVELOPMENT OF NUCLEAR POWER

"The splitting of the atom has changed everything save our modes of thinking, and thus we drift towards unparalleled catastrophe." A. Einstein

What are the liabilities that we find in the current development of nuclear power, and what are the self-perpetuating structures which extend and support nuclear energy development despite its liabilities? A quarter century ago it seemed that atomic fission would become the ideal source of energy for the future. It was available in almost limitless supply, and experts were convinced that it could be used to produce electricity economically and without significant danger to humans or the environment. After a generation of experience, however, those assumptions have been brought sharply into question. Evidence now strongly indicates that nuclear power in its present form is unsafe, uneconomical and unsound ecologically. Three Mile Island has served the important purpose of raising the debate concerning the acceptability of nuclear power from the level of esoteric discussion to public consciousness.

Even before Three Mile Island, strong voices were challenging the industry's optimistic estimates of safety based largely on the Rasmussen Report, a 1976 study of the possibility and consequences of a nuclear accident. Just two months ago a Nuclear Pegulatory Commission team of scientists concluded that Rasmussen's projections were overly-optimistic and impossible to document by his methods. More recently the NRC has closed five plants because of safety deficiencies. The fact is that we simply do not know how safe nuclear reactors are, and Three Mile Island – an accident of the type that was said to be "almost impossible" – has not helped to build confidence in the safety of nuclear power. In regard to health, the Tri-State Leukemia Survey and other studies of the actual incidence of leukemia and other cancers show that the risks of radiation may have been underestimated by a factor of 10 to 20.

Another problem which even the advocates of nuclear energy acknowledge to be unresolved is the disposal of nuclear wastes, some of which require 2,000 years to deteriorate. No safe location has yet been found in which to store these products; meanwhile they pile up at nuclear reactor sites, where plans are underway to increase storage facilities, which will in turn increase the danger, should an accident occur.

Furthermore, nuclear energy's promise to be an inexpensive fuel remains unfulfilled. The Edison Institute estimates that cost per kilowatt-hour is about the same for atomic plants as for coal-fired plants. Such figures, however, include neither the billions in tax dollars already invested in research and development nor the future costs of waste storage and plant decommissioning nor the expense of repair of damaged plants such as TMI. In addition there will inevitably be an increase in the cost of insurance to utilities in the wake of Three Mile Island. Similar considerations have led energy consultant Charles Komanoff to conclude that today atomic power is four times as expensive as oil for the production of electricity.

C. STRUCTURES

How have we gotten ourselves into this position and why is it so difficult to extricate ourselves from it? To a large extent this situation is a consequence of prior value choices which, having assumed a life of their own, have become powerful forces over us, holding us in the grip of their own power. We are not singling out certain individuals or organizations as scapegoats. Rather we point to powerful structures which we ourselves have participated in creating and which we have allowed to become rooted in our lives in a way that is destructive and yet difficult to dislodge. Four such structures of evil, each quite different from the others, become apparent to us as the result of TMI, and we name them below.

1) The most basic and pervasive of these is the American standard of consumption, generating what Roger Shinn has called "the monstrous energy binge of the affluent societies of the 20th century." A basic assumption of those who argue that nuclear energy must be part of our energy mix for the foreseeable future is that we in the United States cannot change our lifestyle in a way that will significantly reduce our voracious and ever-growing appetite for energy. We are the biggest energy consumer in the world, and also by far the most wasteful. We consume forty percent of the world's irreplaceable resources. (George Wald) It must be conceded that appeals to conserve energy have met with only slight and usually temporary success. The "American Standard of Living" holds us tenaciously in its grip, and it has become a demonic power in our time, hindering us from acting not only on this question but on such related issues as world hunger and environmental pollution. An appropriate response to the energy crisis will be possible only if this "power" over us is broken.

2) What might be called "technolatry" also holds us in its sway. Technology is certainly not to be regarded as evil: the best engineering techniques will be required if we are to meet our future energy needs. Yet the mesmerizing magic of technology has beguiled us into a false worship of technology, as if it could by its own power solve all our problems. We have placed our trust in its sophisticated hardware, advanced equipment and large-scale operations. Particularly in the field of nuclear energy, we have encouraged technology to follow its own lead without waiting to collect sufficient data on environmental, medical and social impact. Along with this has gone the naive faith that technology can solve whatever problems might emerge along the way and that technologists rise above the limitations and the self-interest which characterize the activities and opinions of all the rest of us. The result today is a heavy investment in highly sophisticated nuclear technology which, from the very fact of that investment, draws momentum to perpetuate itself. Only if this idolatry can be broken can we hope to make an adequate response to the energy crisis.

3) Very strong economic and political structures have now been built upon the foundation of nuclear power, notably the public utilities with investment in nuclear power, the construction industry which builds their plants, and the Nuclear Regulatory Commission, which is entrusted with the conflicting double responsibility of both promoting and regulating the use of nuclear power. This complex of industry and government represents vast wealth and enormous political clout. Its interest is naturally in protecting its own huge investment (e.g., $1 billion in Three Mile Island alone) and in increasing the profitability of nuclear energy. Abandoning nuclear power would thus have immense economic consequences for this industrial complex and, indeed, for the whole nation. Une must therefore logically anticipate from industry representatives every effort to suppress and minimize findings that emphasize the high costs and dangers of nuclear energy. Only if such entrenched power can be counterbalanced by public, political power in such a way that the true values of nuclear energy can be accurately assessed will it be possible to make a sound response to the energy crisis.

4) Perhaps the most debilitating of the evil powers we face, however, is yielding to a pervasive sense of impotence and apathy to take any action which will significantly affect the centers of power where decisions are made. The

opinion is widespread that forces beyond our control are determining our economic and political future, and that all efforts by ordinary citizens to shape that future are futile. This amounts to a cynicism with respect to both our Christian and our democratic heritages. This cynicism is in sharp contrast to the call to become "co-creators" with God and "artisans of a new humanity." Only if our bondage to an enervating sense of powerlessness can be broken can an effective response to the energy crisis be made.

At times in history an occurrence takes place which breaks the seemingly inevitable sequence of events and opens up new possibilities for creative participation in the shaping of history. Selma, Kent State and Watergate were occasions of this kind. Three Mile Island is also such an event, a moment of truth in which the grip of the "powers" over us is at least temporarily broken. In such a moment our values are judged and we are given a suddenly-expanded opportunity to decide the course of our future. If the Church is of God, then surely it is called to play a leadership role in such a time. In response to Three Mile Island we summon the Church to pray, to think and to act.....

April 6, 1979

FACING NUCLEAR TERROR IN HARRISBURG

William C. Mielke

For a few days in late March and early April the Harrisburg-Three Mile Island area in Pennsylvania faced the possibility of a nuclear disaster. When the threat subsided, residents had undergone a traumatic experience. Community leaders tried to reflect on what had happened. One such leader was William C. Mielke, pastor of Olivet Presbyterian Church in Harrisburg. Mr. Mielke, the Red Cross volunteer coordinator of disaster services for lower Dauphin County, opened and managed the Red Cross emergency shelter in Hershey at the request of the Dauphin County Office of Emergency Preparedness, upon recommendation of Governor Richard Thornburgh.

Here is his analysis of what happened to the community:

Harrisburg, Pennsylvania.

WE MUST begin the task of theological reflection in the aftermath of the Harrisburg-Three Mile Island nuclear accident. None of us has recovered sufficiently from the emotional shock to have much confidence in our ability to think clearly.

The response of our community to the crisis was one of pathetic faithlessness. The whole tenor of our reaction was secular: we are the masters of our fate. To date, all available evidence suggests that the nuclear accident itself caused minor if any physiological harm, even when projected on a long-term statistical basis. But our response to this nuclear threat has had a devastating psychological effect on this metropolitan area. Life in our community will now be different and less stable. Rumors have shaken our level of trust, and stress has shortened lives.

I

We need to examine the threat and our reactions to it. The danger on Wednesday March 28 was a small amount of radioactive gas; on Friday evening it was the possibility of massive nuclear contamination of the entire urban area. The reaction of the community was to flee. An April Fool's Day headline in the *Harrisburg Patriot News* read: "Those 'Uncomfortable' Urged to Exit." Forgetting community responsibilities for those too helpless, too alone, too sick or too poor to leave, many residents took the headline's advice; they got the hell out of town and hoped to survive.

Any sense of community is delicate and precious. Yet, forgetting the human dimension, we were not able to maintain our sense of community, but could think only of the immediate survival of the maximum number of individuals. We perceived community only in physical terms – radiation damage, transportation strategy, food and shelter – not in terms of psychological terror. While the reactor was in a cooling mode, one-third of the residents of the metropolitan area escaped, and the rest cowered in a survival mode, ready to flee.

At least two agendas demand intensive investigation by the religious community: first, Three Mile Island introduced the Western world to the real dimensions of the urban terror which advanced technologies have brought us. The issue is not simply nuclear power but our actual vulnerability to our machines. The sheer size of the nuclear and chemical threat stretches the imagination of individuals and families beyond the breaking point. Only a few days ago a semitrailer of phosphorous just happened to blow up in downtown Gettysburg. This time we are faced with the modern equivalent of the Philistine god Moloch, complete with its oracle, the Nuclear Regulatory Commission, and an hour-by-hour commentary on the god's digestive problems! At least from the perspective of central Pennsylvania, the prospects for technological terror seem to be increasing.

II

The more subtle theological issue involves the significance of safety devices and procedures. The Three Mile Island trauma shattered some myths about safety. Clearly, safeguards do not reduce the degree of technological threat, only the possibility of the occurence of a disaster. Thus we need to be honest about the whys and wherefores of our carefully designed and computer-actuated control procedures. Now we are up against our understanding of human sin and the perfectability of machines made by humans. Second, none of us in North America is prepared for mass urban terror. Apparently we have paid too little attention to the urban experience of London, Berlin and Stalingrad. Better evacuation plans and refinement of our present emergency-preparedness mentality are most definitely not the answer. We are looking at terror in peacetime. Three Mile Island's terrors now potentially threaten every metropolitan area.

The self-evacuation allowed the people most mobile and most terrified by our nuclear god to move out first. As a result, the level of care declined in hospitals and nursing homes. Patients and inmates who needed special help understood well this abandonment and will not easily forget. However, on their own initiative the administrators of both the Lutheran and Oddfellows nursing homes in Middletown

evacuated their residents. The community has applauded these caring initiatives. Elsewhere legal and economic considerations squashed any responses of simple human caring. Probably as people dribbled out of the area, the potential evacuation problems for the rest of the community increased rather than decreased.

Individuals who could have left but chose to remain stayed for a variety of reasons: mandated employment, protection of private property, Yankee stubbornness, some sense of community responsibility. Most households experienced a brief and brutal exercise in value clarification. Each person had to reach his or her own bottom line. Daniel Shutters, pastor of Zion Lutheran Church in nearby Dauphin and a disaster-action team member at the Red Cross shelter, wrote in his diary:

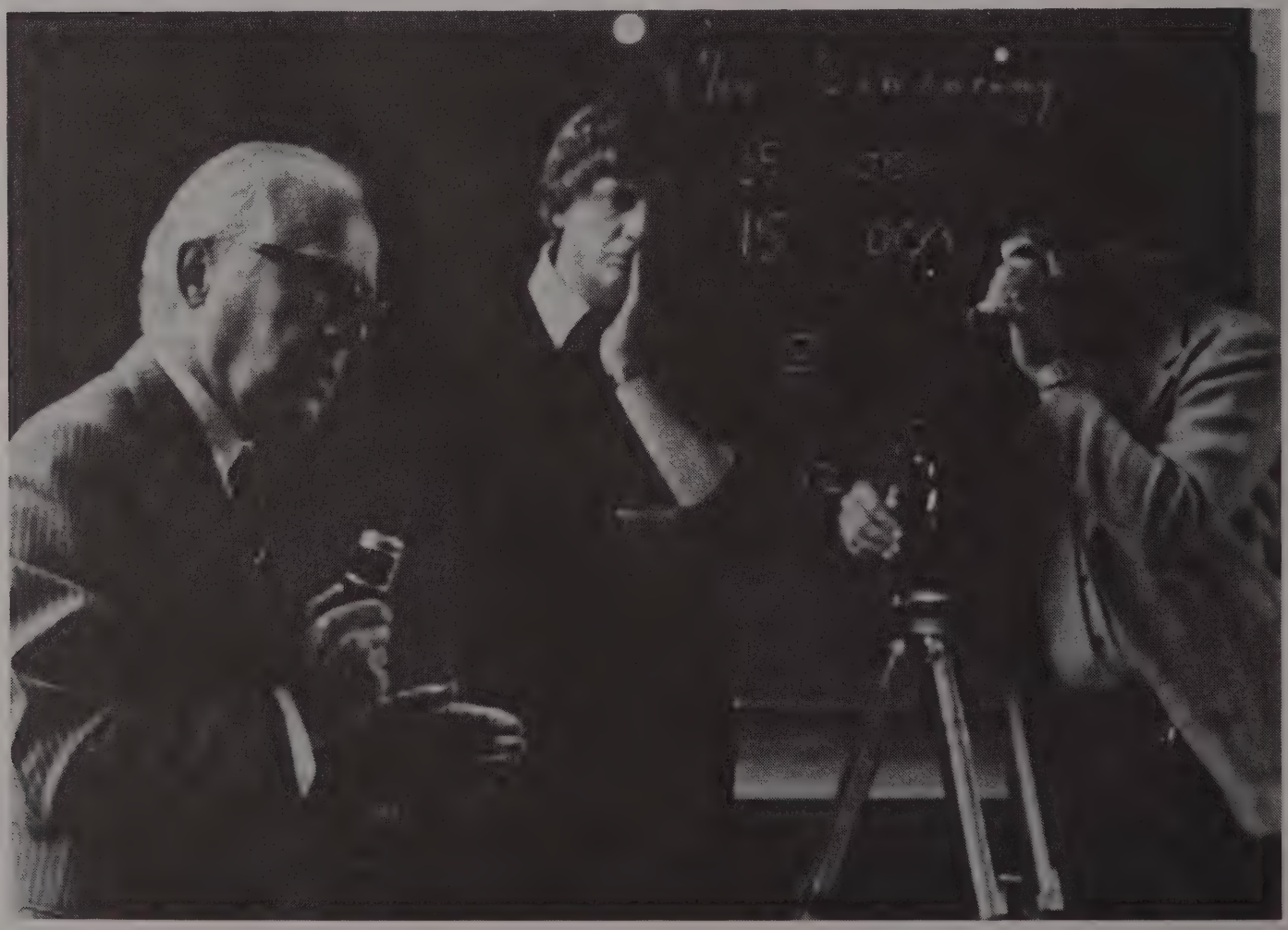
> *March 31, 11:30 P.M.; Arranged family album pictures in a pile on sofa for quick removal. Gas can is in the trunk, as well as hammer, screwdriver and ax. I can't figure out why I need them but I put them in the car nevertheless. Looked around our home. I'm not the only one who is thinking this might be our last few days here forever. "Keep calm," I tell myself. What will I preach tomorrow? The sermon will have to preach itself – I'm too tired. Lord, we shall go on, one step at a time.*

Since we in *our own* terror did not perceive the mass terror, we made mistakes. Remember the prophets who cried out, "Peace, Peace," when there was no peace? We urged everyone to keep calm when no one could be calm. Thus we were not able to imagine concrete activities for dealing with our terror. It took six days for us to discover that we needed a rumor control center! Schools closed, church attendance dropped off, all manner of community activities were canceled, the Harrisburg Symphony concert was called off, and doctors were urged to discharge patients from hospitals. The community collapsed. In attempting to provide calm leadership, public officials communicated psychological dishonesty. We assured ourselves that everything was under control when assuredly very little was making sense. One radio announcer summed up the response of the media: "The only decent thing we did was not to air a recording of 'Waltzing Matilda'" (the song played at the end of the film *On the Beach*). If a manual has been written setting forth the faithful response of God-fearing people to mass urban terror, we haven't found a single copy. But beneath this response lies a value question, and behind that, a faith issue. In our affluence, we simply may have become theologically and ethically lazy.

So far as I can figure out, the rest of the nation also was transfixed by this nuclear terror god. Did anyone consider that even under the threat of evacuation, human resources in addition to nuclear automations might be needed in Harrisburg? No one thought, no one suggested, no one asked, no one came. After long hours of stress many community leaders were "wiped out" with fatigue and needed replacements. Other leaders were so vulnerable to this threat that voluntary evacuation was the only responsible choice. Never mind the Harrisburg pronouncements that everything was under control. Our handling of mass urban terror is a substantial issue. While the rest of the society rants and raves about nuclear energy, we in the theological community must address the terrifying implications of our technological captivity.

(from THE CHRISTIAN CENTURY, April 18, 1979)

Director General Sigvard Eklund of the IAEA, presents his views to the W.C.C. Consultation



V

Conference of Science Students

Science students meet at Wellesley College, USA, and participate in the World Conference at MIT

"The responsibility that now confronts humanity is to make deliberate transition to a sustainable global society in which science and technology will be motivated to meet the basic physical and spiritual needs of people, to minimize human suffering and to create an environment which can sustain a decent quality of life for all peoples."

(From a statement of the World Council of Churches' Fifth Assembly at Nairobi, December 1975)

For five days prior to the World Conference on Faith, Science and the Future, approximately 100 students of natural science, engineering, social sciences and theology, many of them with experience far beyond their academic studies, will meet to discuss issues of particular interest to them as young people concerned with the "process of transition" called for in the statement from the 1975 WCC Assembly in Nairobi. This is the first ecumenical occasion for a substantial number of young scientists and engineers from many parts of the world to meet with each other. Meeting at Wellesley College, Wellesley, Mass., U.S.A., July 6-11, 1979, they will represent a wide range of countries, cultures, scientific disciplines, and Christian denominations, including a sizeable number of Roman Catholic students. Other religions will also be represented. There will be approximately equal numbers of men and women.

Science Center at Wellesley College – the conference meeting place.

The programme of the Wellesley Conference has been prepared by students. The preparatory process began at a five day meeting at Reading University (Great Britain) in July 1978. The issues identified by this international group of twenty students were circulated for comment and submitted to a further preparatory group convened at Cambridge, Mass., U.S.A. (January 1979) which completed a *Prospectus* for the Conference which was sent to all WCC member churches, National Christian Councils, Student Christian Movements, and many youth groups and individuals around the world.

A final preparatory meeting bringing together about fifteen students from widely different national and scientific backgrounds took place at the Ecumenical Institute, Bossey, near Geneva at the end of March 1979. On this occasion the structure of the programme for the Wellesley Conference was prepared.

The 100 student participants have been chosen with the help of the WCC Youth Department, the World Student Christian Federation, and the WCC member churches. The majority of them will come from countries of the Third World.

The *Prospectus* outlines three themes which have been suggested as major foci of the discussion at Wellesley College:

1. The Nature of Science and the Nature of Faith

Each of us, on the basis of our personal experience and social background, formulates an idea of what constitutes science and what constitutes faith. We are often led to see science and faith as very different ways of viewing ourselves and the world in which we live. So we have to come to some decision about the nature of the relationship between them.

Members of the preparatory group at Bossey in March 1979 finalizing the plans for the Science Students Conference.

Many students concerned with science find this task extremely difficult and troubling because the two seem so separate in philosophy, language, areas of concern and methodology. Yet their very divergence poses the challenging question whether one is of more fundamental importance than the other. Some conclude that they are indeed completely separate and that no conflict exists; others find that one denies the "truthfulness" or basic integrity of the other, and still others believe that they are compatible and that a synthesis with intellectual integrity is possible.

Such decisions have consequences, not only for clarifying one's beliefs, but also in relation to what can or, more important, should be done with scientific and technological knowledge. As individuals attempt to answer these questions they often find it difficult to identify how an ethics that is appropriate for dealing with scientific and technological questions, can be related to their beliefs, fundamental faith, ideology or guiding principle.

In the conference, students will be able to share their insights and experience in dealing with the issues of faith and science and science and ethics.

2. Science Education

Education is a critical link between science, technology and the future, because it is a primary vehicle in the preservation, transmission and transformation of values. Education is a process of crucial importance to the welfare of any society. Institutions for the education of scientists, engineers and technicians do not exist independently of the hopes and needs of the societies which support them and their nature varies according to the social and political context. Many students wonder about the values they are being taught and ask how they are being prepared to meet the hopes and needs of their societies. Students know that scientists and engineers are expected to address many of the difficult problems facing our world and that they will themselves bear some responsibility for dealing with these problems.

The conference will serve as a forum where students from many backgrounds can share their insights into science education as they have experienced it.

3. An Assessment of the Modes of Production, Distribution and Use of Science and Implications for Strategies of Social Change

In many parts of the world, today's young people feel caught in a syndrome of social and economic crises: hunger and malnutrition, unemployment, ecological imbalance, militarism, cultural alienation, etc. While realizing the positive potentials of science, they often feel that the advance of science and technology, and more particularly the current modes of their production, distribution and use, have contributed to the deterioration of the quality of life rather than to its improvement. However, the overwhelming complexity of the interrelationship between the dynamics, goals and effects of science and technology and their social, economic and political contexts seems to defy any precipitate answer to the demand for an anlytical framework which might constitute the basis for action towards social change. There is nevertheless an urgent need to clarify some essential aspects of such an analytical framework in order to provide some orientation, as students today struggle to find alternative paths of social and economic development.

After their own meeting the students will attend the World Conference at MIT as full participants, contributing from the perspective of their own experiences. It is envisaged that they will continue to meet together informally throughout the World Conference.

A group of 80 stewards will also take part in the Conference at MIT. They will serve the Conference and will have an opportunity to discuss the issues of particular concern to them.

The next issue of *Anticipation* (to be published in September) will report on the Science Students Conference and present its findings and papers, along with background material on the problem of science education today.

If you are interested in any further information, please write to:

Peter Scherhans,
Organizing Secretary,
Science Students Conference,
World Council of Churches,
Sub-Unit on Church and Society,
150, route de Ferney,
CH-1211 Geneva 20

VI

A Tribute to Margaret Mead

Many people in the OIKOUMENE knew Dr. Mead as Margaret. She had the ability to make friends and also to provoke, to stimulate, to open a dialogue, to relate – she was a great communicator. This ability often dismayed some of her fellow scientists. How could anyone with such wide ranging concerns and interests be a disciplined scientist?

Yet that very quality to relate, to be involved in the urgent questions of the day was perhaps her greatest contribution. It takes whole people to build a holistic society.

A journalist once hesitantly asked Margaret why she carried a forked staff. The reply was typical: "I find it helps people to start a discussion".

She was a liberated person long before womens liberation was in vogue and she helped many others in that search.

Margaret Mead served on the World Council's Church and Society Working Committee from 1962 to 1975 and represented its programme at two WCC Assemblies: Uppsala 1968 and Nairobi 1975.

When Paul Abrecht first asked her to serve on this World Council Committee she accepted reluctantly, then plunged into the work with a kind of electricity that sparked off others. She was one of the leaders of the World Conference on Church and Society in 1966.

Dr. Mead participated in a great variety of international and local conferences. You would find her totally engaged in the centre of the significant debates. She said that the ecumenical movement was her favorite forum and it was here that third world voices came through strong and clear and where real dialogue could take place across barriers of race and nation, culture and language. She was disappointed when in 1975 after fourteen years as a member of the Working Committee she was rotated off.

Margaret was a dedicated member of her Church – a faithful and devout Christian believer. She was particularly critical of Christian Conferences and Consultations which did not include serious worship experiences.

The Conference in MIT in July owes much to her inspiration. She will no doubt be present in spirit.

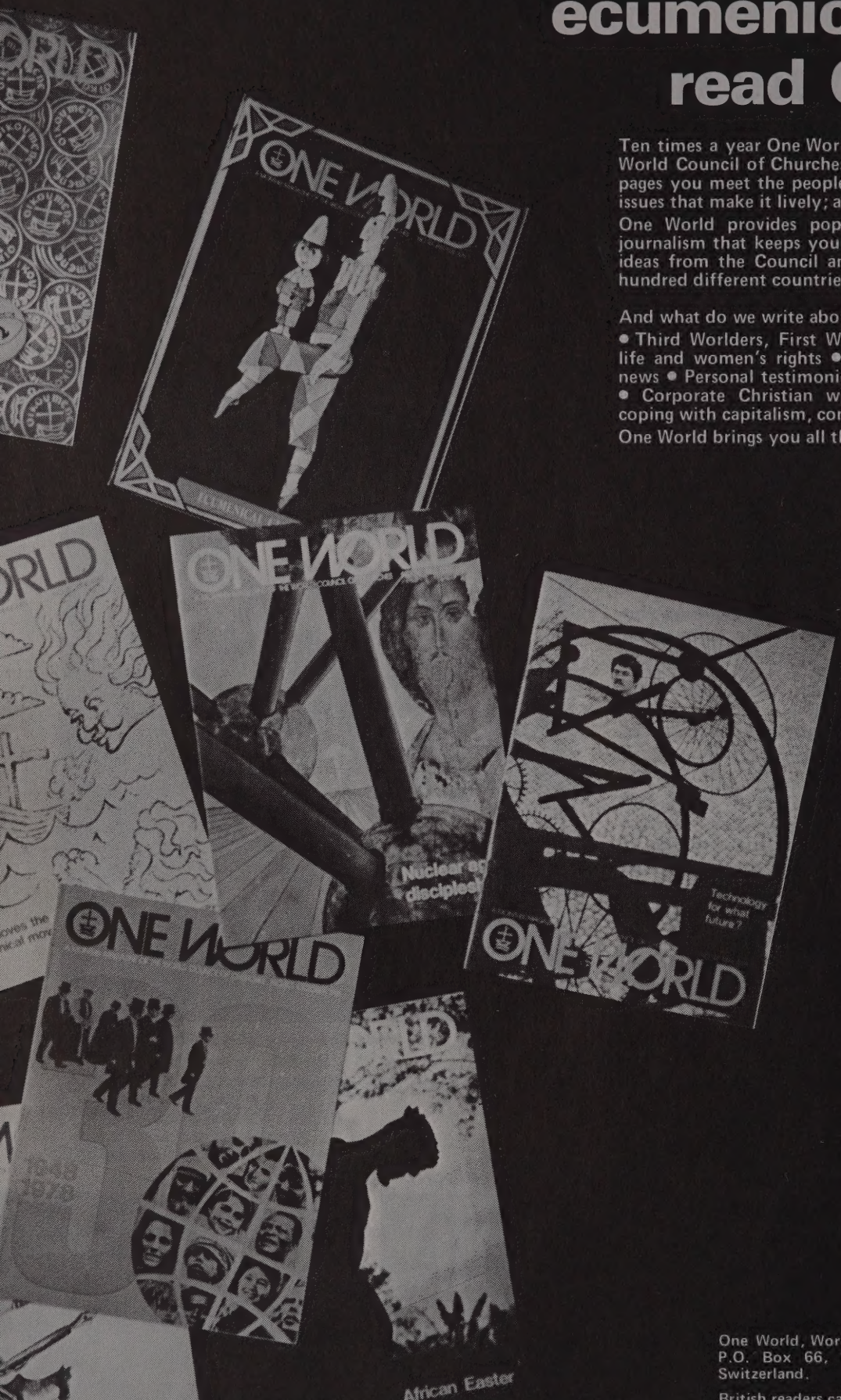
John P. Taylor

Addressing the 1966 World Conference on Church & Society in Geneva.

Margaret Mead with His Holiness ILIA II, Patriarch of the Orthodox Church of Georgia (USSR) in 1974. The Patriarch has since been elected a President of the World Council of Churches.

At an informal meeting with younger theologians during the 1966 Conference on Church & Society.

For the wider ecumenical picture, read One World



Ten times a year One World brings you the inside story about the World Council of Churches and the ecumenical movement. In our pages you meet the people who lead the movement; explore the issues that make it lively; and share the faith it serves.

One World provides popular, personal and sometimes critical journalism that keeps you up to date with ecumenical action and ideas from the Council and its 293 member churches in over a hundred different countries.

And what do we write about?

• Third Worlders, First Worlders, Second and Fourth • Worship life and women's rights • Bible studies and background to the news • Personal testimonies that make life-and-death differences • Corporate Christian witness around the world • Churches coping with capitalism, communism and just plain confusion.

One World brings you all this and more.

One World, World Council of Churches, Publications Office, P.O. Box 66, 150 route de Ferney, 1211 Geneva 20, Switzerland.

British readers can write to:

British Council of Churches, 2 Eaton Gate, London SW1W 9BL, England.

American readers can write to:

World Council of Churches, Room 1062, 475 Riverside Drive, New York, NY 10027.

The basic rates are as follows: Europe, North America, Japan and South Africa: US$ 10.00 a year.
Africa, Asia, Latin America, the Caribbean and the Pacific: US$ 7.00 a year.

Enclose your payment or, if you prefer, we'll bill you later.